MachairWind Offshore Windfarm

Chapter 10 Marine Mammals and Leatherback Turtle

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GLOSSARY OF ACRONYMS

Term	Definition
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AIS	Automatic Identification System
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
AUV	Autonomous Underwater Vehicles
BAP	Biodiversity Action Plan
BEIS	Business Energy Industrial Strategy
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
CEF	Cumulative Effects Framework
CES	Crown Estate Scotland
CGNS	Celtic Greater North Sea
CMS	Construction Method Statement
COMPASS	Collaborative Oceanography and Monitoring for Protected Areas and Species
CPT	Cone Penetration Test
CSIP	Cetacean Strandings Investigation Project
CWSH	Coastal West Scotland Hebrides
DAERA	Department of Agriculture, Environment and Rural Affairs
DAS	Digital Aerial Surveys
DoL	Depth of Lowering
DRC	Dose Response Curve
ECC	Export Cable Corridor
EDR	Effective Deterrent Range
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electro-magnetic Field
EMP	Environmental Management Plan
EPS	European Protected Species
ETG	Expert Topic Group

Term	Definition
FCS	Favourable Conservation Status
HF	High Frequency
HND	Holistic Network Design
HRA	Habitats Regulations Appraisal
HWDT	Hebridean Whale and Dolphin Trust
IAC	Inter-array cables
IAMMWG	Inter-Agency Marine Mammal Working Group
INNS	Invasive Non-Native Species
INSPIRE	Impulsive Noise Propagation and Impact Estimator
IoM	Isle of Man
iPCoD	Interim Population Consequences of Disturbance
IS	Irish Sea
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
LSE	Likely Significant Effect
MBES	Multibeam Echo Sounder
MCAA	Marine and Coastal Access
MD-LOT	Marine Directorate Licensing and Operations Team
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observer
MNR	Marine Nature Reserves
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MU	Management Unit
NA	North Atlantic
NAMMCO	North Atlantic Marine Mammal Commission
NCMPA	Nature Conservation Marine Protected Area
NEQ	Net Explosive Quantity
NI	Northern Ireland
NMFS	National Marine Fisheries Service
NMP	National Marine Plan
NPF4	National Planning Framework 4
NPWS	National Parks and Wildlife Service

Term	Definition
NRW	Natural Resource Wales
O&M	Operation and maintenance
OAA	Option Agreement Area
OnTDA	Onshore Transmission Development Area
ORCA	Organisation Cetacea
OSP	Offshore Substation Platform
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment 1992
OW	Offshore Waters
PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivores in Water
PMF	Priority Marine Features
PTS	Permanent Threshold Shift
RA	Risk Assessment
RIAA	Report to Inform Appropriate Assessment
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SBP	Sub bottom Profiler
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCOS	Special Committee On Seals
SCPTs	Seismic Wave Cone Penetration Tests
SEA	Strategic Environmental Assessment
SEL / $L_{E,p}$	Sound Exposure Level
SEL_{cum} / $L_{E,p,t}$	Cumulative Sound Pressure Level
SEL_{SS} / $L_{E,p,ss}$	Single Strike Sound Exposure Level
SMASS	Scottish Marine Animal Stranding Scheme
SMP	Sectoral Marine Plan
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SPL / L_p	Sound Pressure Level
SPL_{peak} / L_p -pk	Peak Sound Pressure Level
SSC	Suspended Sediment Concentration

Term	Definition
SSS	Side Scan Sonar
TTS	Temporary Threshold Shift
UHR	Ultra-high resolution
USBL	Ultra-Short Baseline
USV	Uncrewed Surface Vehicles
UXO	Unexploded Ordnance Clearance
VHF	Very High Frequency
VSP	Vertical Seismic Profiling
WCC	West Coast Community
WDA	Windfarm Development Area
WDC	Whale Dolphin Conservation
WI	Western Isles
WS	West Scotland
WTG	Wind Turbine Generator
ZoI	Zone of Influence

GLOSSARY OF TERMS

Term	Definition
Bathymetry	Topography of the seabed.
Cable protection	Protective measure to minimise the effects of scour and hazards along the offshore cables (e.g. to prevent cable exposure or snagging of vessel anchors or fishing gear), as well as for protecting these cables at infrastructure crossing points.
Combined Assessment	A whole-Project assessment considering interactions between the Windfarm Development Area, Offshore Export Cable Corridor and Onshore Transmission Development Area (i.e. considering impact interactions and additive effects to determine if any effects would be materially elevated from those assessed for the Windfarm Development Area-alone assessment). Due to long delays in securing confirmation of the Project's grid connection location, the level of detail available for the Offshore Export Cable Corridor and Onshore Transmission Development Area is limited and therefore the assessment is commensurate with the level of detail available at the time of carrying out the assessment. Within the upcoming Offshore Export Cable Corridor and Onshore Transmission Development Area consent applications, their respective scoping and Environmental Impact Assessment Report / Environmental Report will take account of all likely effects predicted within the WDA EIA and present updated combined assessments using the latest available information covering all aspects of the Project.
Cumulative Effects Assessment	Assessment of likely significant effects resulting from the incremental change caused by other past, present and reasonably foreseeable projects / activities together with the Project. This is separate to combined effects arising between the Project's separate Development Areas.
Development Area	Application boundary for consenting purposes which, for the Project, consists of a Windfarm Development Area, Offshore Export Cable Corridor, and Onshore Transmission Development Area. Separate consent and marine licence applications will be submitted for each Development Area where applicable.
Embedded mitigation measure	Mitigation measures, including industry good practice measures, that are directly incorporated into the design for the MachairWind Windfarm Development Area to avoid or reduce environmental effects.
Environmental Impact Assessment (EIA)	The process of evaluating the likely significant environmental effects of a proposed development over and above the existing circumstances (or 'baseline').
Environmental Impact Assessment (EIA) Regulations	A collective term referring to The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
EIA Scoping Windfarm Development Area (WDA) Boundary	The 510 km ^{2} WDA boundary presented at the Project's EIA Scoping Stage.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive as transposed by the Habitats Regulations and comprise Special Areas of Conservation and Special Protection Areas. In accordance with Scottish Government and UK Government policy, candidate SACs, potential SPAs and Ramsar sites are also afforded equivalent protection for assessment purposes, despite not being formally designated European sites.
Habitats Regulations	A collective term used to describe the Conservation of Habitats and Species Regulations 2017 and The Conservation (Natural Habitats, &c.) Regulations 1994.

Term	Definition
Highest astronomical tide (HAT)	The highest level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.
Holistic Network Design (HND) process	An integrated approach for connecting 23 GW of offshore wind (including from ScotWind projects) to Great Britain providing a recommended offshore and onshore design for a 2030 electricity network, that facilitates the Government's ambition for 50 GW of offshore wind by 2030. The recommended design in the HND has equally considered four objectives to make sure the most appropriate approach is taken forwards, including: cost to consumer, deliverability and operability, impact on environment; and impact on local communities.
Inter-array cables (IACs)	Armoured cable containing electrical and fibre optic cores which link the wind turbine generators to each other and to the offshore substation platform(s).
Lowest Astronomical Tide (LAT)	The lowest level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.
MachairWind Offshore Windfarm	An offshore windfarm capable of exporting around 2 GW of renewable energy to the National Electricity Transmission System. MachairWind Offshore Windfarm comprises three Development Areas: • The WDA – located on the west coast of Scotland to the northwest of Islay and west of Colonsay; • The Offshore Export Cable Corridor – a preliminary boundary extending from the WDA to mean high water springs at a landfall location near Girvan, South Ayrshire; and • The Onshore Transmission Development Area – a preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cable(s) and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission. Separate consent and licence applications will be submitted for each Development Area.
Management Units (MUs)	The MUs provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in-combination, need to be assessed for the marine mammal species in UK waters, with consistency across the UK.
Marine Mammal Screening Area	Based on species specific MUs used for marine mammal species reference populations defined from the Inter-Agency Marine Mammal Working group (IAMMWG, 2023) and the Special Committee on Seals (SCOS) seal monitoring units.
Mean sea level	The average level of the sea taking account of all tidal effects but excluding surge events.
National Electricity Transmission System	The high-voltage electricity power transmission network serving Great Britain which receives electricity from generators (such as offshore windfarms) and transmits that electricity to anywhere on the National Electricity Transmission System to satisfy demand.
Offshore cables	The collective term for all offshore cables i.e. IACs, offshore substation platform link cables, offshore export cable(s) and associated fibre optic cables.
Offshore ECC infrastructure	The offshore transmission infrastructure located within the boundary of the Offshore Export Cable Corridor, namely the offshore export cable(s).
Offshore export cable	Armoured cable containing electrical cores between the offshore substation platform(s) and landfall. Offshore export cable(s) will include bundled fibre optic cables. The offshore export cable(s) are subject to Marine Licence applications under the Marine

Term	Definition
	(Scotland) Act 2010. The portion of the offshore export cable(s) located within the WDA is assessed as part of this MachairWind WDA EIA and a marine licence application to construct, alter or improve this portion has been submitted alongside the WDA application. A separate marine licence application will be submitted for the portion of the offshore export cable(s) from the WDA boundary to mean high water Mean High Water Springs.
Offshore Export Cable Corridor (ECC)	The preliminary boundary extending from the WDA to mean high water springs near Girvan, South Ayrshire and within which the offshore export cable(s) will be located. A separate marine licence application will be submitted for the offshore export cable(s) located within the Offshore ECC.
Offshore Substation Platform (OSP)	An offshore platform with a fixed foundation located within the WDA which houses electrical equipment such as transformers, switchgear, protection and control systems, and enables the windfarm's renewable electricity to be collected via inter-array cables and exported to the National Electricity Transmission System via offshore export cable(s).
Offshore Substation Platform (OSP) link cables	Electrical cables which link OSPs (if more than one OSP is required). These cables will include fibre optic cores or bundled fibre optic cables. OSP link cables will be wholly located within the WDA.
Onshore Transmission Development Area (OnTDA)	The preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cable(s) and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission. This Transmission Owner is responsible for consenting the high voltage direct current switching station. Onward connections to the National Electricity Transmission System will be consented by National Grid Electricity Transmission and ScottishPower Transmission. Where relevant, these are considered as part of cumulative effects assessment in the EIA.
OnTDA infrastructure	The onshore transmission infrastructure, for which the Applicant is responsible, that is located primarily within the OnTDA, up to mean low water springs, and includes but is not limited to: landfall(s), onshore export cable(s), transition joint bays, telecom/SCADA infrastructure including vehicular access, joint bays, link boxes and temporary construction compounds. The OnTDA infrastructure will be subject to a planning application under the Town and Country Planning (Scotland) Act 1997.
Operational life	The operational life is the expected length of time from final commissioning of the WDA until the cessation of commercial operations. This is anticipated to be 35 years.
Option Agreement Area (OAA)	The seabed area awarded to ScottishPower Renewables in January 2022 through the ScotWind leasing round.
OSPAR	OSPAR started in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources of marine pollution and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. OSPAR is so named because of the original Oslo and Paris Conventions ("OS" for Oslo and "PAR" for Paris).
Permanent Threshold Shift (PTS)	A permanent total or partial loss of hearing sensitivity caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Plan Option	A spatial plan area proposed through the Sectoral Marine Plan for offshore wind energy (as adopted in 2020). As part of the ScotWind leasing round, offshore wind developers submitted bids for Plan Options which, following a successful bid, become OAAs.

Term	Definition
Pre-construction works	Pre-construction works are activities undertaken prior to formal commencement of construction. Examples include survey works such as geotechnical and geophysical surveys and seabed preparation activities.
Rochdale Envelope	An approach to environmental assessment which aims to take account of the need for flexibility in the future evolution of the detailed project proposal. The approach is named after two court rulings concerning outline planning applications for a proposed business park in Rochdale.
Safety zones	An area of water around or adjacent to a wind turbine generator or Offshore Substation Platform and associated substructure which is to be constructed, extended, operated or decommissioned, from which certain or all classes of vessels are excluded and within which activities can be regulated for the purpose of securing safety of the wind turbine generator, substructure or vessels in that vicinity, and individuals on both the wind turbine generator, substructure or vessel, in line with Section 95 of the Energy Act 2004.
Scottish Marine Area	The area of Scotland's territorial sea limit (up to 12 nautical miles from baseline) as defined in the Marine (Scotland) Act 2010.
ScotWind	A Crown Estate Scotland seabed leasing round which enabled developers to propose offshore wind projects and apply for seabed rights to plan and build windfarms in Scottish waters.
Scour protection	Protective measures to avoid sediment being eroded away from the base of the wind turbine generator foundations as a result of the flow of water.
The Applicant	The legal entity submitting consent applications for the MachairWind Offshore Windfarm, namely MachairWind Limited.
The Lighthouse	The Dubh Artach lighthouse.
The Project	MachairWind Offshore Windfarm including all its Development Areas and associated infrastructure.
Temporary Threshold Shift (PTS)	A temporary reduction in hearing sensitivity caused by acoustic trauma.
Windfarm Development Area (WDA)	The application boundary within the OAA where consent will be sought for the proposed WDA infrastructure. The WDA infrastructure is subject to Section 36 consent and marine licence applications (generation and transmission) which are being applied for separately from the Offshore ECC infrastructure and OnTDA infrastructure.
WDA infrastructure	The offshore generation and transmission infrastructure located within the WDA including but not limited to: WTGs, WTG fixed foundations (and associated scour protection), OSP(s), OSP fixed foundations (and associated scour protection), IACs, OSP link and offshore export cable(s) and their associated external cable protection (insofar as these are located within the WDA) and fibre optic cables.
Wind Turbine Generator (WTG)	A wind turbine generator which converts wind energy into electrical energy. Each wind turbine generator is a complex system composed of a high number of components. Typically, the main components include the rotor assembly (composed of three blades and a hub); the nacelle (containing a generator, shaft and gearbox, power electronic converter and transformer); and the tower (containing lifting equipment and the switchgear).

10 MARINE MAMMALS AND LEATHERBACK TURTLE

10.1 INTRODUCTION

1. This chapter presents an assessment of potential impacts and likely significant effects (LSE) on marine mammals and leatherback turtle that may arise from the construction, operation and maintenance (O&M), and decommissioning of the MachairWind Windfarm Development Area (WDA) infrastructure.

2. The grid connection location for the Project was confirmed in August 2025 following lengthy delays stemming from the National Electricity System Operator's 2022 Holistic Network Design (HND) process (see **Chapter 1 Introduction** for further information). Consequently, this topic chapter considers the WDA and existing environment only. Separate consent and marine licence applications will be sought for the Offshore Export Cable Corridor (ECC) and Onshore Transmission Development Area (OnTDA). A combined assessment of the construction, O&M and decommissioning of the WDA activities, Offshore ECC and OnTDA activities (commensurate with the level of detail that is available at the time of carrying out that assessment) is also provided in this chapter. This approach will ensure a holistic view is undertaken of the entire Project. As noted in **Chapter 1 Introduction**, the assessment of LSE on all receptors associated with the Offshore ECC and OnTDA will be presented in individual Environmental Impact Assessment (EIA) Reports (EIARs), which will be submitted separately in accordance with the relevant EIA Regulations.

3. This chapter considers the following WDA infrastructure: wind turbine generators (WTGs), Offshore Substation Platforms (OSP) and associated fixed foundations and scour protection, Inter-array cables (IACs), OSP link cables, the portion of the offshore export cable located within the WDA and associated cable protection.

4. This chapter has been prepared to provide the Marine Directorate Licensing and Operations Team (MD-LOT) (on behalf of the Scottish Ministers) and stakeholders with sufficient information to determine the LSE(s) of the Project on the receiving environment.

5. This chapter should be read in conjunction with the following related EIAR chapters:

   - **Chapter 9 Fish (Including Basking Shark) and Shellfish;** as potential impacts on these receptors may cause indirect effects (i.e., through changes to prey resources) on marine mammals;
   - **Chapter 12 Commercial Fisheries;** as potential impacts on commercial fisheries receptors may cause indirect effects (e.g., through changes to prey resources) on marine mammals; and
   - **Chapter 13 Shipping and Navigation;** as increased vessel activity within and on transit to the WDA may impact marine mammals, this chapter will be used to inform behavioural disturbance impacts from vessels and vessel interaction (i.e., increased risk of collision).

6. Key inter-relationships between this chapter and those listed above will be considered where relevant and presented in this chapter.

7. Additional information to support the marine mammal assessment includes:

   - **Appendix 10.1 Underwater Noise Modelling Report**;
   - **Appendix 10.2 Marine Mammal and Leatherback Turtle Baseline**;
   - **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data**;
   - **Appendix 10.4 Interim Population of Consequences of Disturbance (iPCoD) Modelling Technical Report**;
   - **Appendix 10.5 Cumulative Effects Assessment Screening**; and

- **Appendix 10.6 Unexploded Ordnance Clearance Assessment**.

8. This chapter was prepared by Haskoning.

10.2 LEGISLATION, POLICY AND GUIDANCE

9. The overarching policy and legislation relevant to the EIA is described in **Chapter 2 Policy and Legislative Context**. **Table 10.1** sets out the relevant legislation, policy and guidance that informs the assessment for marine mammals and leatherback turtle.

Table 10.1 Summary of relevant legislation, policy and guidance for marine mammals

Relevant Policy or Guidance	Relevance to the Assessment
Legislation	
Nature Conservation (Scotland) Act, 2004	The Nature Conservation (Scotland) Act 2004 sets out a series of measures designed to conserve biodiversity, and to protect and enhance the biological and geological natural heritage. This Act also provides amendments to the Wildlife and Countryside Act 1981 specifically for Scottish waters, adding that it is an offence to disturb cetacean species (either recklessly or intentionally). This Act also enacts requirements under the Bern Convention 1979.
Marine and Coastal Access (MCAA) Act 2009	Marine Protected Areas (MPAs) existing beyond the 12 nm limit in Scottish Waters and Marine Conservation Zones (MCZs) in English waters are designated under the MCAA 2009. These sites (MPAs and MCZs) are areas that have been designated for the purpose of conserving – marine flora and fauna; marine habitat or types of marine habitat; or features of geological or geomorphological interest. The Nature Conservation Marine Protected Area (NCMPA) network, designated under the above legislation, includes several NCMPAs which protect marine features such as minke whale (*Balaenoptera acutorostrata)*.
Marine (Scotland) Act, 2010	This Act provides a framework for the sustainable management of Scotland's seas and one of its key aims is to streamline and simplify the licensing and consenting process for marine projects. Under the Marine (Scotland) Act, the Conservation of Seals Act 1970 was repealed, with new provisions introduced to allow Seal Conservation Areas to continue to benefit from protection and providing designation of specific seal haul-out sites for protections from intentional or reckless harassment. Under Part 6 of the new act, it is an offence to kill, injure or take a seal at any time of year, except to alleviate suffering or where a licence has been issued to do so by MD-LOT.
Oslo and Paris Convention for the Protection of the Marine Environment 1992 commission	Oslo and Paris Convention for the Protection of the Marine Environment 1992 (OSPAR) commission established a group on Offshore Renewable Energy Developments, ICG-ORED, in 2021 which is taking the lead in progressing tasks and actions related to OSPAR's North-East Atlantic Environmental Strategy 2030 Operational Objective S12.O4: By 2024 OSPAR will develop guidance to promote and facilitate sustainable development and scaling up of offshore renewable energy in a way that cumulative environmental impacts are minimised. This is guided by the application of the Ecosystem Approach. Understanding and assessing cumulative effects is the front line of implementing an ecosystem-based approach to the management of human activities in the OSPAR Maritime Area.
Conservation of Habitats and Species Regulations 2017 and The Conservation (Natural Habitats, &c.) Regulations 1994 (Habitats Regulations)	Applies to Marine Licences and Section 36 applications within the Scottish inshore region. The Habitats Regulations place an obligation on 'competent authorities' to carry out an Appropriate Assessment (AA) of any proposal likely to have a significant effect on a European site, to seek advice from Statutory Nature Conservation

Relevant Policy or Guidance	Relevance to the Assessment
	Bodies (SNCBs) and to reject an application that would have an adverse effect on the integrity of a European site except under very tightly constrained conditions. Under the Habitats Regulations, all cetacean species and marine turtles are defined as European Protected Species (EPS). All seals are listed under Schedule 3 (animals which may not be captured or killed in certain ways).
Protection of Seals (Designated Seal Haul-out sites) (Scotland) Order 2014	Order designated protected seal haul out sites.
Policy	
National Planning Framework 4 (Scottish Government, 2023)	The National Planning Framework 4 (NPF4) sets out Scotland's spatial principles, regional priorities, national developments and national planning policy. NPF4 presents Sustainable Places, Liveable Places and Productive Places to achieve national outcomes including benefits to the environment, communities, and health. NPF4 contains a notable focus on tackling both the climate and nature crises. **The key references are:** **Policy 3: Biodiversity** – *"Development proposals will contribute to the enhancement of biodiversity, including where relevant, restoring degraded habitats and building and strengthening nature networks and the connections between them. Proposals should also integrate nature-based solutions, where possible…"* **Policy 4: Natural places** – "*Development proposals that are likely to have a significant effect on an existing or proposed European site (Special Area of Conservation or Special Protection Areas) and are not directly connected with or necessary to their conservation management are required to be subject to an "appropriate assessment" of the implications for the conservation objectives…*"
Scotland's National Marine Plan, 2015	Scotland's National Marine Plan (NMP) sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nautical miles (nm), whilst highlighting that marine mammals are a strategic priority. **The key references are:** **Policy GEN 9 Natural Heritage:** "*Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species (b) not result in significant impact on the national status of Priority Marine Features (c) Protect and, where appropriate, enhance the health of the marine area…*" **Paragraph 4.41:** "*A network of well managed marine protected areas is being established to meet national objectives and help deliver an ecologically coherent MPA network in the North East Atlantic, contributing to the protection and enhancement of the area to which this Plan applies. The network will comprise of newly designated Marine Protected Areas as well as Natura Sites and marine components of Sites of Special Scientific Interest and*

Relevant Policy or Guidance	Relevance to the Assessment
	Ramsar sites. The management requirements of each of these designation types must be met. These sites, together with other protected areas will make a significant contribution to the protection, enhancement and health of the marine area. Improved health of the marine environment will also lead to increased resilience of ecosystems to climate change…" **Paragraph 4.42:** "*Sites designated as Special Areas of Conservation and Special Protection Areas make up the Natura 2000 network of protected areas. Any plan or project likely to have a significant effect on these sites, which is not directly connected with or necessary to their conservation management, must be subject to an 'appropriate assessment' of their implications for the site in view of its conservation objectives...*" **Paragraph 4.46:** "*Marine Protected Areas are those designated under the Marine Acts to protect features of importance to Scotland and which will contribute to an ecologically coherent network of sites. MPAs are identified according to the guidelines on the selection and development of the MPA network...*" **Paragraph 4.51:** "*The presence (or potential presence) of a legally protected species is an important consideration. If there is evidence to suggest that a protected species is present or may be affected by a proposed development, steps must be taken to establish their presence. The level of protection afforded by legislation must be factored into the planning and design of the development and any impacts must be fully considered prior to the determination of the application...*" **Paragraph 4.55:** "*Marine planning can deliver significant improvements to management of our seas by contributing to improvement in the status of Priority Marine Features and their associated habitats, species and ecosystems...*" **Note:** When published, Scotland's National Marine Plan (NMP2) will also be considered and is assumed to supersede the existing NMP.
Scottish Biodiversity Strategy to 2045 (Scottish Government, 2024)	Sets out a vision for 2045 explaining how the government will conserve biodiversity for the people of Scotland now and in the future with the objective to halt the loss of biodiversity.
Priority Marine Features (PMF) in Scotland's Seas (NatureScot, 2020)	PMFs are habitats and species that have been identified as being conservation priorities in Scottish waters. These include 16 species of marine mammals.
Sectoral Marine Plan (SMP) for Offshore Wind Energy (2020) and Scottish Government (2025) Draft updated Sectoral Marine Plan for Offshore Wind Energy, Option Area W1 – May 2025	The SMP for Offshore Wind Energy identifies sustainable areas for the future development of commercial scale offshore wind energy in Scotland, including a spatial strategy to inform the seabed leasing process for the purposes of offshore wind energy. The WDA is located in Plan Option W1, as identified in the SMP for Offshore Wind. Plan Options including W1 were subject to testing, refinement and area reduction through Strategic Environmental Assessment (SEA), Habitats Regulations Appraisal (HRA) and plan development processes. The SEA identified relevant

Relevant Policy or Guidance	Relevance to the Assessment
	characteristics of Plan Option W1 and identified key risks to be addressed in consenting applications. A key risk factor identified for the W1 area was potential impacts on marine mammal receptors.
Marine Environment: 'Unexploded Ordnance Clearance (UXO) Joint Position Statement' (UK Government et al., 2025)	This position statement sets out how the signatories expect to approach marine licensing for these activities and provides guidance to potential applicants as to how best to undertake applications for such marine licences, in the context of this general approach.
UK Marine Policy Statement	Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets. (Introduction). The marine environment plays an important role in mitigating climate change. (2.2). Biodiversity is protected, conserved and where appropriate recovered and loss has been halted. (2.2). Places duties on public bodies in relation to the conservation of biodiversity and strengthens wildlife enforcement legislation. Wild animal protection is extended to include reckless as well as intentional acts. The Act makes it an offence to disturb or harass cetaceans and amends the provisions for enforcement. (4A).
Argyll and Bute Local Development Plan 2 (2024)	**The key references are:** **Policy 28: Supporting Sustainable Aquatic and Coastal Development –** *"Proposals for marine and freshwater aquaculture, marine and coastal developments will be supported where it can be demonstrated that there will be no significant adverse effects, directly, indirectly or cumulatively on…"* **Policy 73: Development Impact on Habitats, Species and Biodiversity –** *"When considering development proposals Argyll and Bute Council will give full consideration to the legislation, policies and conservation objectives, contained within the following…"* **Policy 74: Development Impact on Sites of International Importance –** *"Unless development is directly connected with or necessary to their conservation, proposals likely to have a significantly adverse effect, including cumulative, upon an existing or proposed Special Protection Area, existing or candidate Special Area of Conservation, or Ramsar Site (i.e. European Sites), including development outwith the site, shall require appropriate assessment…"*
Guidance	
The Protection of Marine EPS From Injury and Disturbance – Guidance for the Marine Area in England and Wales and the UK Offshore Marine Area (Joint Nature Conservation Committee (JNCC) et al., 2010).	The guidance intends to provide a resource for marine users, regulators, advisors and the enforcement authorities when considering whether an offence of disturbing or injuring/killing a marine EPS is likely to occur or to have occurred as a result of an activity.

Relevant Policy or Guidance	Relevance to the Assessment
Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise (JNCC, 2010).	The JNCC guidelines for piling outline a protocol for the mitigation of potential underwater noise impacts arising from pile driving during the construction of an offshore windfarm.
JNCC Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys (Seismic Survey Guidelines) (JNCC, 2017).	The JNCC guidelines for geophysical surveys outline a protocol for the mitigation of potential underwater noise impacts due to geophysical surveys.
Scottish Marine Wildlife Watching Code (Scottish Natural Heritage (SNH) [now NatureScot], 2017).	The Scottish Marine Wildlife Watching Code provides guidelines as to the best practice measures for reducing disturbance to marine mammals by all marine users.
Marine mammal noise exposure criteria (Southall et al., 2019; National Marine Fisheries Service (NMFS), 2018; 2024)	The marine mammal noise exposure criteria provide thresholds for noise impacts on marine mammals using species hearing group criteria for both impulsive and non-impulsive sounds, providing Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) thresholds in Sound Exposure Level (SEL / $L_{E,p}$) and Sound Pressure Level which is used for the underwater noise modelling.
Marine Scotland (2018). Consenting and Licensing Guidance: For Offshore Wind, Wave and Tidal Energy Applications. Scottish Government.	This guidance provides a framework for offshore wind for environmental assessments.
The Protection of Marine EPS From Injury and Disturbance – Guidance for Scottish Inshore Waters (Marine Scotland, 2020).	This guidance provides advice for marine users who are planning to carry out an activity in the marine environment which has the potential to deliberately or recklessly kill, injure or disturb a marine EPS. It also provides useful information on mitigation for marine mammals.
JNCC guidance for the use of Passive Acoustic Monitoring (PAM) in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023)	These guidelines outline measures for the use of PAM of marine mammals in UK waters for mitigation.
JNCC Guidelines for minimising the risk of injury to marine mammals from unexploded ordnance (UXO) clearance in the marine environment (JNCC, 2025a).	These guidelines outline measures to minimise potential injury from UXO clearance.
Marine licensing – UXO: application guidance (Department for Environment Food and Rural Affairs ((Defra), 2025)	Guidance on marine licensing application requirements for UXO clearance.

10.3 CONSULTATION

10. Consultation for marine mammals and leatherback turtles has been informed by engagement with stakeholders, including those listed below:

- Argyll and Bute Council;
- Department of Agriculture, Environment and Rural Affairs (DAERA);
- Hebridean Whale and Dolphin Trust (HWDT);
- Islay Natural History Trust;
- MD-LOT;
- NatureScot; and
- Whale and Dolphin Conservation (WDC).

11. As part of the consultation process, the Applicant presented the approach to assessment to stakeholders to offer transparency around the scoping methodology and rationale, capture stakeholder advice and guidance, and incorporate stakeholder feedback, where appropriate. A summary of the approach to stakeholder communication and consultation is outlined in **Chapter 6 Consultation and Stakeholder Engagement**.

12. The consultation outcomes in relation to marine mammals and leatherback turtle are outlined in **Table 10.2** which summarises stakeholder feedback, outlines how the Applicant has responded to the feedback received, and details how it has been considered within this chapter.

13. In addition to the engagement outlined in **Table 10.2** the points of agreement between the Applicant and NatureScot are listed below:

- During the first Expert Topic Groups (ETG) meeting, 04 December 2023: NatureScot agree with the approach to iPCoD "*The demographic parameters for each species will be based on the latest available information and follow best practice for iPCoD modelling (e.g., Sinclair et al., 2020), however we are expecting new best practice information to be available soon. As well as modelling the 25-year disturbance, The NRW (2023) approach will be used: A decline of >1% per year (versus a modelled unimpacted reference population) over a 6-year period following first disturbance will result in a significant effect. It is advised to look at both the six year and 25 years*". The iPCoD results are presented in **Sections 10.12.1.6.3.1** and **10.13.3.1.1.3.2**; with the methodology presented in **Appendix 10.4 IPCoD Modelling Technical Report**.
- During the first ETG meeting, 04 December 2023, NatureScot were in agreement with the approach to underwater noise modelling (see **Appendix 10.1 Underwater Noise Modelling Report**).
- During the Marine Mammals Scoping workshop on 01 May 2024, it was agreed with NatureScot that for the Cumulative Effects Assessment (CEA), geophysical surveys should be included, with a justification for excluding zones e.g., Moray Firth, so that NatureScot can provide a response to the reasoning. A justification was presented at the second ETG meeting 15 October 2025; where the CEA screening area was presented based on the Wider Study Area (see Figure 1.1 in **Appendix 10.5 CEA Screening**). It was agreed with NatureScot at the second ETG meeting that a six-month cut off period would be applied whereby other projects which submit their applications six months prior to submission of the WDA application will not be considered in the CEA due to there being insufficient time to include in the assessment. Geophysical surveys have been included in the CEA (see **Section 10.13.3.1.3**).
- From the Scoping Opinion; (09 January, 2025) NatureScot and Argyll and Bute Council agree with the list of marine mammal and turtle species proposed to be scoped into the assessment as provided in **Section 10.8** being generally content with those listed. Quantitative assessments should be undertaken where density estimates are available (see **Section 10.12**).

Table 10.2 Summary of consultation relevant to marine mammals and leatherback turtle

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
Pre-Scoping Opinion (including Scoping Workshop and Expert Topic Groups (ETG))				
1.	NatureScot	04 December 2023: ETG Meeting 1	NatureScot suggested that additional existing data could be obtained from the Whale and Dolphin Conservation (WDC) shore watch, Marine Mammal Atlas and Orca survey data which could be considered in scoping and the Environmental Impact Assessment Report (EIAR).	Additional data sources have been included in **Table 10.3** in **Section 10.4**.
			NatureScot requested that long finned pilot whale (*Globicephala melas)* and humpback whale (*Megaptera novaeangliae*) should be scoped into the assessment.	Long-finned pilot whale and humpback whale have been scoped in for further assessment. See Sections 5.8 and 6.3 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**.
2.	Department of Agriculture, Environment and Rural Affairs (DAERA)	04 December 2023: ETG Meeting 1	DAERA highlighted that in Northern Ireland, there is a dedicated Management Unit (MU) for seals as well as a significant colony of grey seals (*Halichoerus grypus*) with an expanding population on Rathlin Island.	The Northern Ireland (NI) seal MU has been included in the assessment to account for connectivity from the NI and the Scottish MUs which accounts for grey seal on Rathlin Island as described in Sections 7.1 and 7.2 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**.
3.	NatureScot	09 February 2024: ETG Meeting 1 follow-up advice (email)	NatureScot do not agree with the use of Temporary Threshold Shift (TTS) onset thresholds as a proxy for disturbance for impact piling, as it is understood that animals can be disturbed at lower levels than TTS thresholds. When assessing disturbance, NatureScot advise the use of dose response curves (Graham et al. 2017) from harbour porpoises (*Phocoena phocoena*) for all cetacean species and that Waggitt et al. (2019) is stated for Harbour Porpoise and while this is a useful data source for baseline characterisation, we would advise the use of SCANS IV (or SCANS III / Digital Aerial Surveys if either gives a higher estimate).	TTS has not been used to inform the assessment of disturbance from underwater noise due to piling. To assess disturbance from piling, dose response curves (DCR), Effective Deterrent Ranges (EDRs) and population modelling have been applied in **Section 10.12.1.6**. For harbour porpoise, the density estimate taken forward for the assessment is from the Project's Digital Arial Survey (DAS) as agreed with NatureScot through correspondence following ETG 2 (see **Table 10.6** and **I.D. 56** of this table).

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
4.	NatureScot	09 February 2024: ETG Meeting 1 follow-up advice (email)	For impacts during operation and maintenance, NatureScot confirmed that vessel interaction and presence of vessels needs to be separated. NatureScot further suggested that direct electromagnetic field (EMF) effects on marine mammals could be scoped out of the assessment with only indirect effects of EMF on prey species being required to be assessed in the mammals' chapter.	Noted, potential impacts, such as auditory injury or disturbance due to the vessel noise is assessed in **Section 10.12.1.8**. Vessel interaction (increased collision risk) is assessed in **Section 10.12.1.10**. EMF effects on prey species are assessed in **Section 10.12.1.12**.
5.	NatureScot	MachairWind Marine Mammals Scoping workshop / 01 May 2024	For density estimates, for harbour porpoise - use SCANS IV estimate of 0.02/km^2 as more up to date than Waggit et al. (2019) and more precautionary than DAS. Risso's dolphin - use Project DAS estimate. Long finned pilot whale - NatureScot content with use of CS-G (adjacent block) density estimate due to the sensitivity of pilot whales. Leatherback turtle, use Project DAS and include in mammal scoping chapter. To be assessed qualitatively.	Noted, this advice has been followed, see **Table 10.6**.
6.	NatureScot	MachairWind Marine Mammals Scoping workshop / 01 May 2024	For Dose Response Curve assessment, it is advised to use Graham et al. (2017). Also for seals use Whyte et al. (2020).	This advice has been followed. See **Section 10.12.1.6 (10.12.1.6.2.1.1)** for DCR assessment for cetaceans and pinnipeds.
7.	NatureScot	MachairWind Marine Mammals Scoping workshop / 01 May 2024	It is noted that auditory injury is proposed to be scoped in for operational noise, other construction activities and vessel noise however if noise modelling indicates no potential for this, then it can be scoped out. These noise impact pathways should be scoped in for disturbance. TTS can be used as a proxy for UXO disturbance but for all other non-impulsive noise impact pathways, dose response curves should be used for assessment.	Acknowledged. Following the results from the underwater noise modelling; auditory injury from non-piling activities is assessed in **Section 10.12.1.7**. Auditory injury from vessels is assessed in **Section 10.12.1.8**. TTS is used as a proxy for UXO disturbance however the DCRs produced by Graham et al. (2017), Graham et al. (2019) and Whyte (2020) were all derived from impulsive noise (piling). They would therefore be very unrealistic and overly precautionary to apply to non-impulsive sound sources.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
				Consequently, EDRs have been used to assess disturbance from non-piling activities, which was presented in the Scoping Workshop and NatureScot responded in the Scoping Opinion (see comment I.D. 18) "*We would welcome both Effective Deterrent Radius's (EDRs)"* (See **Section 10.12.1.7.3.2**).
8.	NatureScot	MachairWind Marine Mammals Scoping workshop / 01 May 2024	In agreement with what is scoped into NCMPA assessment. However, if floating is put back in design envelope, then further consideration required.	Acknowledged. See the **Report to Inform Marine Protected Area Assessment** for assessment of marine mammal NCMPAs. Floating WTG technology is not included within the Project's design envelope.
Scoping Opinion				
9.	NatureScot	09 January 2025: Scoping Opinion	The proposed study area is defined in Section 10.6 as the Windfarm Development Area (WDA), with wider consideration of each species in the context of their relevant MU. We advise that the study area should be the WDA plus the 10km DAS buffer and that the wider study area should be the UK portion of each marine mammal species MU.	Reference in the WDA Scoping Report to the study area being solely the WDA was an error. The Marine Mammals and Leatherback Turtle Study Area (hereafter 'Study Area') is defined by the Option Agreement Area (OAA), plus a 10 km. However, given that marine mammals are highly mobile predators, their status and activity within or adjacent to the Study Area is considered in the context of their MUs and the UK portion of each species' population as part of a Wider Study Area (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).
10.	NatureScot	09 January 2025: Scoping Opinion	We are content with the data sources, and we are advising to continue using the National Marine Fisheries Service (NMFS) (2018) / Southall et al. (2019) thresholds for assessments as we are not yet in a position to recommend using the NMFS 2024 thresholds. If our position changes, we will inform relevant stakeholders, including the Applicant.	NMFS (2018) / Southall et al. (2019) thresholds have been used in the underwater noise modelling for the marine mammal assessment (See **Appendix 10.1 Underwater Noise Modelling Report**). The Applicant confirmed via email correspondence with NatureScot on 22 May 2025 that this advice still stood.
11.	NatureScot	09 January 2025: Scoping Opinion	All species of marine mammals that are identified in the DAS should be scoped in for assessment. We advise that density estimates are generated from site-specific DAS and then the most precautionary estimate between	All marine mammal species and the single leatherback turtle recorded from the Project's DAS have been taken forward for assessment. See **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and **Table 10.6**.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			SCANS IV and DAS is used for the assessment. If there are no density estimates available from SCANS IV, or the SCANS III modelled density surfaces are significantly higher, then SCANS III should be used instead. If this is not available, we can accept Waggitt, et al. (2019). If no density estimates are available, then we would advise assessing the species qualitatively. Proposed marine mammal density estimates are provided in Table 10.5. It is noted in Paragraph 486 that *"For all species except harbour porpoise, the most precautionary densities are proposed to be used…For harbour porpoise, as recommended by NatureScot (Table 10.2), the SCANS IV estimate will be used instead of the most precautionary, as it is the most recent desk-based source and is a higher density estimate compared to the results from the Project's DAS".* This advice was given at the Scoping Workshop prior to the full DAS results being available. Therefore, we advise that the DAS density estimate of 0.253/km2 should be used instead of the 0.201/km2 SCANS IV estimate as it would be more precautionary. In addition, we advise that the highest density recorded for every species should be used, not the seasonal average, except for common dolphin (*Delphinus delphis*). This is due to the presence of common dolphin super pods recorded within the WDA. Although the super pods could be incidental and not representative of the area all year round, there remains the possibility that this is an area that is important for common dolphin life history.	As described at **I.D. 56** of this table, feedback from NatureScot at ETG 2, stated that the highest seasonal average (summer season) for harbour porpoise should be used, rather than the highest monthly density. This approach has therefore been followed for harbour porpoise and other cetaceans such as common dolphin and minke whale. For the final density estimates, where possible the highest density was used from SCANS or the Project's DAS. In cases where this was not available, Waggit et al (2019) densities were overlaid with the SCANS-IV CS-F block and if that was not an option, receptors were assessed qualitatively. For pinnipeds, the highest density was used from the Project's DAS or using Carter et al (2022) or Carter et al., (2025) densities overlaid with the OAA plus 4 km buffer to maintain consistency with other receptors from the Project's DAS densities (further information is provided in Section 2 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).
12.	NatureScot	09 January 2025: Scoping Opinion	A new survey report from the ObSERVE Programme has just been published, which could provide additional context in terms of seasonal migration of common	The survey report from the ObSERVE Programmed has been included in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			dolphins on the west coast and we encourage the developer to continue engagement with the Hebridean Whale and Dolphin Trust (HWDT) to add further context to the assessment of this species. For the bottlenose dolphin (*Tursiops truncatus*) density estimate, we advise that the SCANS IV block CS-F (0.0425/km^2) should be used – it appears that the figure from the adjacent block (CS-G) has been presented in the Scoping Report. For white-beaked dolphin (*Lagenorhynchus albirostris*), we are content with the use of the adjacent block CS-G (0.254/km^2) as there is no density estimate available for block CS-F in SCANS III or IV.	A report utilising HWDT data is presented in **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data**. The density estimates for bottlenose dolphin presented in the Scoping Report was an error, the density SCANS IV block CS-F has been applied (see **Table 10.6**)
13.	NatureScot	09 January 2025: Scoping Opinion	As noted in Table 10.5, both grey and harbour seals will be assessed quantitively using Carter et al. (2020) density estimates, which we support. Just to note, we appreciate the difficulty involved in positively identifying seals to species level from DAS. However, we do not agree with the approach of apportioning unidentified marine mammals to the most common species.	Density estimates for grey seal were calculated using the DAS data, with records categorised as unidentified seal excluded from the apportioning process. The density estimates applied in the assessment were derived from Carter et al. (2022; 2025), with the most precautionary values selected for use in the assessment (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and **Table 10.6**).
14.	NatureScot	09 January 2025: Scoping Opinion	In relation to the reference populations, we advise use of the population estimates for the UK portion of the Inter-Agency marine Mammal Working Group (IAMMWG) MUs rather than the full MUs for species with very large MUs. This is to present the most realistic assessment of numbers of animals affected by the proposal in Scottish waters. The MUs for most species are very large and in most cases are too big for a meaningful understanding of impacts to potentially impacted populations. Although we acknowledge this is based on a non-biological delineation, we feel that using the UK portion of the MU better reflects the likely size of populations affected by the potential impact pathways. The use of population estimates for the	The UK portion of the MU has been used for both the WDA alone assessment (**Section 10.12.1**) and the cumulative assessment (**Section 10.13**). The UK portion of the MUs are presented in **Table 10.6**.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			full MUs are still useful for context and baseline characterisation. Therefore, we advise stating the total MU population for context and then assessing impacts against the UK portion of the MU.	
15.	NatureScot	09 January 2025: Scoping Opinion	The list of marine mammal and turtle species proposed to be scoped into the assessment is provided in Section 10.7.1 and we are generally content with those listed. We agree that quantitative assessments should be undertaken where density estimates are available (as advised above).	Noted – see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and **Table 10.6**.
16.	NatureScot	09 January 2025: Scoping Opinion	It is noted in Paragraph 485 that a single leatherback turtle (*Dermochelys coriacea*) was recorded during the DAS in September 2022. However, our understanding from the DAS report was that in addition to this individual, six leatherback turtles had been recorded in April 2021 within the proposal area. Therefore, we agree that leatherback turtle should be included in the assessment.	The Applicant has confirmed with APEM that the figure of six leatherback turtle records was erroneous and that only one individual was recorded in the Project's DAS. Leatherback turtle has been scoped in, see Section 8.1 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and **Table 10.6**.
17.	NatureScot	09 January 2025: Scoping Opinion	We are broadly content with the scoping in and out of impacts as per Table 10.7 subject to the following comments. We agree that auditory injury from operational noise, other construction activities and vessels may be scoped out based on the underwater noise modelling results. We would not usually expect this continuous, non-impulsive noise to be loud enough to exceed Permanent Threshold Shift (PTS) for any of the functional hearing groups. However, our advice is that if the underwater noise modelling shows that the PTS thresholds could be exceeded then it should be scoped in.	Acknowledged. Following the results from the underwater noise modelling, auditory injury from non-piling activities is assessed in **Section 10.12.1.7**. Auditory injury from vessels is assessed in **Section 10.12.1.8**. Auditory injury (TTS) from operational WTGs is assessed in **Section 10.12.1.13**.
18.	NatureScot	09 January 2025: Scoping Opinion	In addition, we advise that geophysical surveys should be scoped into the assessment. Whilst we acknowledge that European Protected Species (EPS) licences will be sought for these activities separately (as with unexploded	Potential impacts from geophysical surveys are assessed in **Section 10.12.1.3**. Although a separate marine licence for UXO clearance will be applied post-consent, potential impacts from UXO clearance

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			ordinance (UXO) clearance and piling), they should also be considered within the Environmental Impact Assessment (EIA).	(using the best case and worst-case scenario) are presented in **Appendix 10.6 UXO Clearance Assessment on Marine Mammals and Leatherback Turtle.**
19.	NatureScot	09 January 2025: Scoping Opinion	The proposed approach to assessing underwater noise impacts from UXO clearance is set out in Section 1.1.1 of Appendix G (Marine Mammals and Turtles Approach to Assessment), which we are broadly content with. It is stated in Paragraph 8 that an EPS licence will be sought for UXO clearance if there is a potential for significant disturbance to result in a population level effect. We advise that in Scotland an EPS licence is required if the potential disturbance to any individual of any species cannot be ruled out (inshore regulations).	See **Appendix 10.6 UXO Assessments for Marine Mammals and Leatherback Turtle**. An EPS licence will be sought alongside the separate UXO clearance marine licence application post-consent.
20.	NatureScot	09 January 2025: Scoping Opinion	It is acknowledged (Section 1.1.2.2.1, Appendix G) that the use of harbour porpoise dose response (Graham et al. 2017) on all cetaceans is precautionary, however in the absence of species-specific dose response curves, it is the preferred approach for EIA. In relation to seals, we are content with the use of Whyte et al. 2020 for both species – should the updated dose response for harbour seal (*Phoca vitulina*) become available (Whyte et al. 2022) then we advise that both are presented for harbour seal for comparison and consistency between developments.	The assessments using the DCR are presented in **Section 10.12.1.6 (10.12.1.6.2.1.1)** for cetaceans (Graham et al 2017) and for pinnipeds (Whyte et al., 2020). In addition, the deterrent distance-based function (Graham eta l., 2019) has been applied for harbour porpoise only (see **Section 10.12.1.6.2.1.1**).
21.	NatureScot	09 January 2025: Scoping Opinion	We advise that any approach proposed for Northern Irish waters or sites are agreed with DAERA prior to assessment. It is noted in Paragraph 31 (Appendix G) that there are a number of papers that provide potential disturbance ranges from piling (and other activities) that could be used to inform an assessment of disturbance. We would welcome both Effective Deterrent Radius's (EDRs) and dose response underwater noise modelling to be presented to allow comparison. However, we	Noted. To assess any potential disturbance to marine mammals, DCR for harbour porpoise (Graham et al., 2017) has been applied to all cetaceans, and the DCR for harbour seal (Whyte et al., 2020), has been applied to all pinnipeds and the deterrent distance-based function has been applied to harbour porpoise; EDRs have also been used for the assessment (see **Section 10.12.1.6**).

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			appreciate this may add to the work required and thus advise that if only one approach is taken forward, it should be the use of the dose response underwater noise modelling approach.	
22.	NatureScot	09 January 2025: Scoping Opinion	Paragraph 33 (Appendix G) states that population modelling (iPCoD) will be undertaken to determine the population level consequences of disturbance due to piling and will be conducted for all species where there is the required information to support an assessment – we welcome this approach. This should be undertaken for the proposal alone and cumulatively with other developments / activities.	Population modelling has been carried out for the Project (**Section 10.12.1.6.3.1**) and cumulatively with other development/activities (**Section 10.13.3.1.1.3**). Also see **Appendix 10.4 IPCoD Modelling Technical Report**.
23.	NatureScot	09 January 2025: Scoping Opinion	We welcome the approach outlined in Section 1.2.4 (Appendix G) to assess vessel interaction and look forward to seeing this in the EIA Report.	Further consideration of this approach has indicated that this type of assessment is not considered very realistic, as the available Cetacean Strandings Investigation Project (CSIP) and Scottish Marine Animal Stranding Scheme (SMASS) data are not highly quantitative. These datasets represent only a small proportion of overall strandings, with limited post-mortems completed, and are therefore not considered fully representative. Consequently, a qualitative assessment has been presented in **Section 10.12.1.10.**
24.	NatureScot	09 January 2025: Scoping Opinion	The approach outlined in relation to magnitude (Section 10.12, Scoping Report), where the proportion of the potentially impacted population is considered in defining the magnitude of impact to each species is welcomed. Furthermore, we agree that proportion alone should not exclusively define the magnitude of impact as the thresholds drawn could become arbitrary.	Acknowledged. The proportion alone is not used exclusively to define magnitudes and significance of effect; other factors have been considered. This is the case for assessing disturbance to bottlenose dolphin; the Coastal West Scotland Hebrides (CWSH) MU and the west coast community (WCC) killer whale (*Orca orcinus*) population (see **Section 10.12.1**).
25.	NatureScot	09 January 2025: Scoping Opinion	We are broadly content with the definitions of magnitude detailed in Table 10.8, which were the same as those presented at the Scoping Workshop. However, the narrative in Section 10.12.2 is drawn from non-Scottish	Acknowledged. The definitions and magnitudes have been updated and are described in **Section 10.11.1.2**. To assess for disturbance on a population level, population modelling

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			EPS guidance and is therefore not relevant for assessing impacts on population effects for EIA in Scotland.	has been undertaken (see **Appendix 10.4 iPCoD Modelling Technical Report**)
26.	NatureScot	09 January 2025: Scoping Opinion	It is noted from Section 10.12.3 that the value of the receptor is listed in the bullets describing the factors influencing sensitivity. However, it does not seem to have been included in the definition of sensitivity level in Table 10.9 (Definitions of sensitivity levels for marine mammals). Value is then described in Section 10.12.4 where it is noted that just because a species is of high value, it does not make them more sensitive and as all species of marine mammal have high value, the value will only be looked at as a modifier for the sensitivity assigned "where relevant". For clarity, we can accept value being used as a modifier, as we advise that value should be included, so as to acknowledge the inherent value / importance of these species, which are given a high level of legislative protection through the Habitats Regulations.	Acknowledged. Where appropriate, the value of each receptor has been considered when assigning receptor sensitivities in **Section 10.12.1**.
27.	NatureScot	09 January 2025: Scoping Opinion	In relation to auditory injury impacts from underwater noise (piling and UXO clearance), we expect to see a sensitivity score of High for all cetacean species. This is due to the known importance of hearing function to these species, the uncertainty of this impact in the long term as well as the high vulnerability and low recoverability of individuals from the impact.	The sensitivity to permanent auditory injury from piling or UXO clearance has been assigned as high and for temporary auditory injury, the sensitivity has been assigned as medium (see **Table 10.14**).
28.	NatureScot	09 January 2025: Scoping Opinion	In relation to disturbance from piling, we would expect a sensitivity scoring of Medium and for disturbance from UXO clearance we would expect a score of Low or Negligible due to the short duration of impact, particularly if using low order deflagration techniques.	The sensitivity assigned to all marine mammals for disturbance from piling is medium (see **Table 10.14**). The sensitivity assigned to all marine mammals for disturbance from UXO clearance is medium (see **Table 10.14**).
29.	NatureScot	09 January 2025: Scoping Opinion	For marine mammals, we expect the assessment to focus on impacts to cetaceans under EIA legislation. However, there is also a need to consider impacts to cetaceans	Through the definition of worst-case parameters (**Table 10.5**) including e.g. the maximum number of geophysical survey

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			within an EPS context, as far as reasonably practicable. We do not expect a full EPS Risk Assessment at this stage but an understanding of the implications for cetaceans from the proposal under inshore regulations, together with mitigation options. This will provide confidence, should the proposal be consented, that any impact is able to be addressed through a subsequent derogation under EPS licensing. In our experience, leaving this entirely to the post-consent stage can lead to difficulties and delays.	vessels on site at any one time, the assessment of potential impacts on the agreed species' reference populations has been undertaken which will inform any future EPS Risk Assessment. This would also take account of any refinements to Project design and activities in the post-consent phase. Additionally, the JNCC et al. (2010) and Marine Scotland (2020) guidance for the protection of Marine EPS from injury and disturbance has been taken into account in defining levels of magnitude for marine mammals (**Section 10.11.1.2**). Mitigation measures are described in **Section 10.10** and will be reflected in any future EPS Risk Assessment.
30.	NatureScot	09 January 2025: Scoping Opinion	We advise that all impacts are considered cumulatively regardless of the significance of potential impact on marine mammals from the proposal alone assessment. This is because an impact could be of higher significance cumulatively when scaled up from other Projects within the species MU. Due to the location of this proposal, we advise that Northern Irish offshore developments are considered in the cumulative assessment as well as Scottish developments.	All impacts in the EIAR are considered cumulatively (see **Section 10.12.2.6**).
31.	NatureScot	09 January 2025: Scoping Opinion	We recommend including all projects up to a year on either side of the proposal, looking at both temporal and spatial overlap, and advise use of iPCoD to assess the long-term impacts cumulatively for the species it is available for. Where underwater noise outputs are not available for other projects, we can accept the use of EDRs.	Projects with a spatial and/or temporal overlap one year either side of piling at the WDA have been included in the CEA screening (see **Appendix 10.5 CEA screening**). See **Section 10.13.3.1** for the assessment using EDR and iPCoD.
32.	NatureScot	09 January 2025: Scoping Opinion	If the Cumulative Effects Framework (CEF) is published within the proposal timeframe, then we recommend that it is used to undertake the cumulative assessment.	The Applicant understands that the CEF is yet to be published and therefore has not been used in the CEA.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
33.	NatureScot	09 January 2025: Scoping Opinion	We welcome the identification of embedded mitigation described in Section 10.8 and summarised in Appendix A (Mitigation Register). However, as noted previously, much of the embedded mitigation includes adherence to post consent plans / programmes. Plans do not strictly constitute mitigation as it is the measures contained within the plans / programmes that will mitigate impacts for which no detail has been provided yet.	Mitigation measures are described in **Section 10.10**. In addition, **Appendix 9 Draft Marine Mammal Mitigation Protocol (MMMP)** has been submitted with the application which provides options for embedded and additional mitigation measures which could be used in the final MMMP / Piling Noise Mitigation Plan post consent.
34.	NatureScot	09 January 2025: Scoping Opinion	Should significant effects be identified during the EIA, the embedded measures detailed in Section 10.8 may not be sufficient to mitigate impacts.	Mitigation measures have been updated since scoping and as noted above, **Appendix 9 Draft MMMP** has been submitted with the application.
35.	NatureScot	09 January 2025: Scoping Opinion	We advise that if any Uncrewed Surface Vehicles (USVs) or Autonomous Underwater Vehicles (AUVs) are to be used, further advice should be sought to agree appropriate mitigation for marine mammals (and basking sharks).	If the use of USVs or AUVs is required, further advice from NatureScot on appropriate mitigation will be sought in the post-consent phase.
36.	NatureScot	09 January 2025: Scoping Opinion	Monitoring can help reduce the level of precaution within assessments and accelerate the consenting process by providing more proportionate and meaningful EIAs. At this time, it is unknown which or how many offshore windfarm proposals are likely to be consented and of these, will be constructed. As a result, we are encouraging all Applicants to consider post-consent monitoring to help contribute to strategic projects to help fill knowledge gaps that can be addressed in the most efficient and cost-effective way.	See **Section 10.10**.
37.	NatureScot	09 January 2025: Scoping Opinion	We advise that there could be transboundary impacts to the Republic of Ireland from underwater noise impacts and therefore, the National Parks and Wildlife Service should be consulted for further advice. We provide advice above in respect of cross border considerations and the requirement to liaise with DAERA.	See **Section 10.14** and the **Report to Inform Appropriate Assessment (RIAA)**.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
38.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do agree with the proposed data sources? Are there any further data sources to be aware of?** In general, yes. NatureScot may have further data sources. It is recognised that there is uncertainty in the baseline data for marine mammal distributions foraging within or migrating through west coast waters, and therefore, whilst this assessment considers currently available data, it is expected that a detailed project level survey will include possible routes and movements of cetaceans and seals before construction commences to establish a robust baseline against which an assessment can be made. HWDT data request for raw effort and sightings / Passive Acoustic Monitoring (PAM) data within the Option Agreement Area (OAA) would be welcomed. The ObSERVE II Surveys would be welcomed and if possible, should be incorporated into the EIA for the most recent available data.	All recommended data sources have been included in the baseline study, in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**. Data from HWDT has been included in the marine mammal baseline study (see **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data**).
39.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you agree with the potential impacts scoped in and out?** Yes, in general agreement with the potential impacts scoped in and out. Under Table 10.7 *Potential impacts scoped in or scoped out for marine mammals – Direct Effects from Electro-Magnetic Fields*, I would however express concern that relates to the proposed cable laying of sub-sea cables. I would advise that where environmental conditions allow, cable burial should be at a minimum depth of 1.5 m below the seabed to reduce their potential impact to marine mammals**.**	The purpose of cable burial is to ensure that the cables are protected from damage, either from human activities such as fishing and shipping, or from naturally occurring physical morphology processes acting on the seabed. Cable minimum Depth of Lowering (DoL) (i.e. the distance between mean seabed level and the top surface of the buried cable will be between 0.3 m and 3 m but is typically between 1.0 m and 2.0 m in seabed substrates consisting of granular material or soft clay. Where practicable, the Applicant will seek to achieve DoLs of 1.0 m to 2.0 m for all offshore cable types. DoLs of up to 3.0 m may be used for areas experiencing significant seabed mobility or due to an increased external threat, such as crossing shipping lanes. DoLs of 0.3 m may be used for IACs in challenging ground conditions such as shallow outcropping rock, due to the inherent protection it provides the

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
				cable at a shallower DoL. OSP link cables and offshore export cables would, as far as practicable, have a minimum DoL of 1 m. Otherwise, external cable protection methods would be considered such as concrete mattresses, rock placement, rock bags and nature inclusive design solutions (see **Chapter 3 Project Description** for further details). The preferred method of cable protection is through cable burial. The use of external cable protection methods would be avoided as far as practicable, and the Applicant is considering the use of nature inclusive design solutions (see **Chapter 3 Project Description** and the **Nature Positive Plan**). Both cable burial and the laying of external cable protection would increase the distance between Electro-Magnetic Field (EMF) emissions and receptors thus minimising EMF effects.
40.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you advise to use the updated draft marine mammal underwater noise thresholds from National Marine Fisheries Service (NMFS) (2024), or the thresholds published in Southall et al., (2019)?** I would advise that the Applicant use the most recent data from the updated draft marine mammal underwater noise thresholds from the National Marine Fisheries Service. However, this would be subject to NatureScot's recommendations.	Advice from NatureScot (see **I.D. 10** of this table) advised the Applicant to use NMFS (2018) / Southall et al., (2019) which has been used in the underwater noise modelling (see **Appendix 10.1 Underwater Noise Modelling Report**) and for the assessments in this chapter.
41.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you agree that the embedded mitigation measures described provide a suitable means for managing and mitigating the potential effects of the WDA on marine mammal receptors?** Yes, in agreement with the proposed embedded mitigation measures. Particularly welcome the development of the Marine Mammal Mitigation Protocol (MMMP), the development of a Cable Plan that will	**Appendix 9 Draft MMMP** and **Appendix 6 Outline Environmental Management Plan (EMP)** have been submitted with the Section 36 consent application.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			incorporate a Cable Burial Risk Assessment (CBRA), and the development of a Project Environmental Management Plan (PEMP).	
42.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you agree with the approach to underwater noise modelling, and the thresholds to be used (see Appendix G Marine Mammals and Turtles Approach to Assessment)?** Yes, in general agreement with the proposed approach to underwater noise modelling, subject to NatureScot's recommendations.	Acknowledged.
43.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you agree with the proposed approaches to assess the potential for disturbance due to underwater noise?** Yes, in general agreement with the proposed approaches to assess the potential for disturbance due to underwater noise, subject to NatureScot's recommendations.	Acknowledged.
44.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you agree with the approach to cumulative assessments, and the use of population modelling?** Yes, in general agreement with the proposed approach to cumulative assessments and the use of population modelling, subject to NatureScot's recommendations.	Acknowledged.
45.	Argyll and Bute Council	09 January 2025: Scoping Opinion	**Do you have any other matters or information sources that you wish to be presented in the EIAR?** No.	Acknowledged.
46.	MD-LOT	09 January 2025: Scoping Opinion	The Scottish Ministers are broadly content with the study areas as described in Section 10.6 of the Scoping Report, however, highlight the representation from NatureScot regarding the DAS buffer and Management Units and request that this must be fully addressed and implemented in the EIA Report.	See **I.D. 9** and **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.**

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
47.	MD-LOT	09 January 2025: Scoping Opinion	The Scottish Ministers are content with the data sources presented in Table 10.3 and 10.4 of the Scoping Report, however direct the Developer to the NatureScot representation and advise to continue using the thresholds published in the 2018 NMFS for assessments. In addition, the Scottish Ministers highlight the Argyll and Bute Council representation with regards to baseline data assessment for consideration.	See **I.D. 10** of this table.
48.	MD-LOT	09 January 2025: Scoping Opinion	With regards to the baseline information discussed in Section 10.7 of the Scoping Report, the Scottish Ministers highlight NatureScot comments regarding reference populations, density estimates and receptors which should be fully implemented within the EIA Report.	A summary of species' density estimates and reference populations is provided in **Table 10.6**.
49.	MD-LOT	09 January 2025: Scoping Opinion	The Scottish Ministers generally agree with the impacts to be scoped in and out as outlined in Table 10.7 of the Scoping Report. However, the Scottish Ministers advise, in line with the NatureScot representation, that geophysical surveys should be scoped into the assessment. In addition, the Scottish Ministers direct the Developer to the NatureScot representation regarding the scoping in/out of auditory injury from operational noise based on results of underwater noise modelling. Finally, the Scottish Ministers highlight the representation from Argyll and Bute Council with regards to cable burial depth for consideration.	Acknowledged. Potential impacts from geophysical surveys have been assessed in **Section 10.12.1.3**. For auditory injury from operational noise from operating WTG see **Section 10.12.1.13**. See **I.D. 39** of this table for the response on cable burial depth.
50.	MD-LOT	09 January 2025: Scoping Opinion	With regards to the approach to assessment discussed in Section 10.12 of the Scoping Report, the Scottish Ministers highlight NatureScot comments regarding UXO clearance, effective deterrence ranges and sensitivity and magnitude which must be fully addressed and implemented in the EIA Report. In addition, the Scottish Ministers direct the Developer to the representation from	The Applicant has provided responses to these points in this table.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			NatureScot with regards to EPS licence requirements for consideration, and the need to agree approaches to assessment for Northern Irish waters with DAERA prior to assessment.	
51.	MD-LOT	09 January 2025: Scoping Opinion	The Scottish Ministers have reviewed the mitigation measures detailed in Section 10.8 of the Scoping Report and advise that, where impact pathways have been identified, the full range of mitigation measures and published guidance must be included in the EIA Report along with further information on proposed marine mammal monitoring. This view is in line with the NatureScot and Argyll and Bute Council representations. In addition, the Scottish Ministers highlight the representation from NatureScot with regards to survey vehicles for consideration.	Mitigation measures are described in **Section 10.10**. In addition, **Appendix 9 Draft MMMP** has been submitted with the application which provides options for embedded and additional mitigation measures which could be used in the final MMMP / Piling Noise Mitigation Plan post- consent. Information on marine mammal monitoring is presented in **Section 10.10**.
52.	MD-LOT	09 January 2025: Scoping Opinion	With regard to the approach to the cumulative assessment as described in Section 10.10 of the Scoping Report, the Scottish Ministers are broadly content. However, the Scottish Ministers draw attention to the NatureScot representation regarding use of Interim Population Consequences of Disturbance and request that this must be fully addressed in the EIA Report. In addition, the Scottish Ministers advise, in line with NatureScot representation, that Northern Irish offshore developments are considered alongside Scottish developments in the cumulative assessment. Finally, Scottish Ministers recommend in order to assess cumulative impacts, the Developer uses the Cumulative Effects Framework, when published, when compiling the EIA Report.	Northern Irish Projects have been considered in the CEA (see **Appendix 10.5 CEA Screening**). The use of the iPCoD to assess for cumulative disturbance is presented in **Section 10.13.3.1.1.3**.
53.	MD-LOT	09 January 2025: Scoping Opinion	In terms of transboundary impacts, the Scottish Ministers highlight the representation from NatureScot which states	Acknowledged. Transboundary effects have been considered in **Section 10.14.** The Applicant has sought to engage with

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			the possibility of transboundary impacts to the Republic of Ireland, due to underwater noise. The Scottish Ministers therefore recommend the Developer engage further with National Parks and Wildlife Service on this point and advise that these impacts must be assessed, and if appropriate, mitigation proposed in the EIA Report.	National Parks and Wildlife Service (NPWS) throughout the pre-application period, however, was unable to secure a meeting to discuss the Project.
54.	MD-LOT	09 January 2025: Scoping Opinion	In regard to the Marine Protected Area ("MPA") Screening Report, the Scottish Ministers refer to the representation from NatureScot and agree that minke whale (*Balaenoptera acutorostrata*) of the Sea of Hebrides MPA should be screened in for assessment and advise that underwater noise from geophysical survey works should also be scoped in for assessment.	Potential effects from underwater noise from geophysical survey works on the minke whale feature of the Sea of Hebrides MPA have been assessed in the **Report to Inform MPA Assessment**.
55.	DAERA	09 January 2025: Scoping Opinion	DAERA Marine and Fisheries Division welcome the opportunity to comment on this proposal. After reviewing the associated documents, we are content that those Northern Ireland MPA that are within the screening ranges for marine mammals have been included.	Acknowledged. See the **RIAA** which provides the assessment of potential impacts from the WDA on European sites.
Post Scoping Opinion				
56.	NatureScot	Written response to 2nd ETG 14 October 2025	We note for harbour porpoise that the density estimate proposed for the assessment is 0.771/km^2 from March 2022. However, we advise that although the highest monthly density estimates provide context and are useful to see reflected within the assessment, we advise that the average DAS density estimates should be used for the assessment, particularly if they are the highest estimate available (i.e. compared to SCANS). In relation to common dolphin, we are content with the approach proposed – i.e. that the seasonal average is used. This is in line with previous advice provided.	It is noted that the NatureScot Scoping Opinion advice at **I.D. 11** of this table stated that *"we advise that the highest density recorded for every species should be used, not the seasonal average"* however following this post-scoping advice, the highest seasonal average (summer season) for harbour porpoise of 0.42 animals per km^2 has been used for the assessment rather than the highest monthly density. This approach has also been taken for other cetaceans such as minke whale. Long-finned pilot whale and fin whale have only been sighted once in the geophysical surveys in the WDA, and have both

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			In addition, we advise that all species sighted during the geophysical surveys are included in the assessment, even if qualitatively, with information provided in the baseline report on the number and location of each sighting.	been included in the assessment. A summary of density estimates, and reference population is provided in **Table 10.6**.
57.	NatureScot	Written response to 2nd ETG 14 October 2025	We agree that using the PTS SEL_{cum} is likely to be overly precautionary in the time required for the ADD use as mitigation. Going forward as the piling strategy is developed, if the proposal is consented, we recommend further discussion around PTS SPL_{peak} and ADD activation time that may be required to mitigate impacts, particularly given the large impact ranges and increasing humpback sightings on the west coast.	Acknowledged; Acoustic Deterrent Device (ADD) activation times on PTS SPL_{peak} / L_{pk} will be presented in **Table 10.37** (in **Section 10.12.1.6**) alongside a caveat to discuss and agree on ADD activation times during the preparation of the Final MMMP / Piling Noise Mitigation Plan.
58.	NatureScot	Written response to 2nd ETG 14 October 2025	**Do you agree with the approach for auditory injury from non-piling activities?** Yes, we are broadly content with the approach as set out on slide 14 (*using impact ranges from the underwater noise modelling for a stationary receptor rather than a fleeing receptor*). However, no information is provided as to what fleeing speeds were applied for each hearing group, please provide clarity on fleeing speeds used.	Swimming speeds used for the underwater noise modelling is presented in **Appendix 10.1 Underwater Noise Modelling** and in **Section 10.12.1.6**.
59.	NatureScot	Written response to 2nd ETG 14 October 2025	**Do you agree with the approach for auditory injury from the presence of vessels?** Yes, we are broadly content with the approach as set out on slide 15. As above, no information has been provided as to the fleeing speeds applied for each hearing group. In addition, clarification on what evidence underpins the assumption that marine mammals will flee from vessel presence is also required.	
60.	NatureScot	Written response to 2nd ETG 14 October 2025	As per our advice at scoping, we expect use of harbour porpoise dose-response curves from Graham *et al.* (2017) not Graham *et al.* (2019). The proposed shift from the	The Applicant acknowledges this comment and to assess for disturbance, DCRs from Graham et al (2017) will be used.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			generic dose-response to deterrence function is acknowledged. We advise that both the deterrence function and dose-response can be presented in the EIA Report but that the assessment should be based on dose-response.	The deterrence function will be applied exclusively to harbour porpoises for comparative analysis. See **Section 10.12.1.6**.
61.	NatureScot	Written response to 2nd ETG 14 October 2025	We recommend use of the more precautionary 5 km EDR for geophysical surveys (JNCC, 2020).	The Applicant has used the precautionary 5 km EDR to assess for disturbance from geophysical surveys (see **Section 10.12.1.3**).
62.	NatureScot	Written response to 2nd ETG 14 October 2025	No justification has been provided for the use of a 4 km impact range for vessel disturbance, and we would expect any approach to be evidenced and justified within the EIA.	Justification for using a 4 km impact range to assess for disturbance from vessel activity has been described in **Section 10.12.1.8.2.3**.
63.	NatureScot	Written response to 2nd ETG 14 October 2025	We welcome the inclusion of assessing disturbance due to transiting vessels and acknowledge that it is difficult to do so at this stage whilst there is uncertainty over port / harbours / routes etc. However, the route(s) that is / are likely to be the most frequently used should be accounted for within the assessment, rather than the longest distanced route, to ensure the worst-case scenario both spatially and temporally has been assessed. We consider the assessment for disturbance should be considered further if the proposal is consented as part of a Vessel Management Plan and should consider vessel disturbance from all potential pathways for all receptors.	Construction ports will have the highest frequency of vessel transits. Out of the list of indicative ports being considered in this EIAR (see **Chapter 3 Project Description**) Arnish/Stornoway is considered to represent a suitable worst-case scenario for the assessment given that it is the furthest construction port from the WDA (See **Section 10.12.1.8.2.3**). The effects of vessel disturbance have been assessed on a worst-case scenario basis in **Section 10.12.1.8**. If the Project is consented, further refinement of any required mitigation for potential disturbance to marine mammals which is described in **Appendix 6 Outline EMP**, will be provided.
64.	NatureScot	Written response to 2nd ETG 14 October 2025	*Do you agree with the approach for Cumulative Effects Assessment (CEA) screening?* It would be helpful to clarify the details presented on slide 21. Our understanding is that species-specific screening will be applied to the full study area. Therefore, for harbour porpoise only projects that fall within the West Scotland MU will be considered? Clarification on this point	The CEA includes species specific screening and will include projects in: • Harbour porpoise West Scotland (WS) MU. • Bottlenose dolphin - Offshore Waters (OW), CWSH, • Celtic Greater North Sea (CGNS) and North Atlantic (NA) populations will include projects in the full range.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			is required before we advise on what portion of the MU should be used in the CEA.	• Seals - Wider MU (WS, South-west Scotland (SWS), Western Isles (WI), Republic of Ireland (RoI), and Northern Ireland (NI). See Figure 1.1 in **Appendix 10.5 CEA Screening**. Clarification to NatureScot was submitted via email on 19 December 2025, with written feedback received on 06 February 2026 (see third bullet point in **Paragraph 13**).
65.	NatureScot	Written response to 2nd ETG 14 October 2025	It is noted that one method to assess the cumulative effects from piling is via the iPCoD model, which we would recommend. However, it states that the project proposes to include the worst-case disturbance number (from either DRC, EDR etc.) and the number of animals at risk of PTS based on the SPL. It is unclear why the project is proposing to include SPL_{peak} alongside disturbance in the iPCoD model for the CEA. All projects should mitigate for PTS based on the SPL_{peak}. We would be content if the proposal assessment includes the SEL_{cum} PTS numbers in iPCoD modelling as it has been established that this impact cannot be fully mitigated for.	In the iPCoD modelling, the Applicant is proposing to use the SEL_{cum} PTS numbers for all species with exception of minke whale. Haskoning have contacted Rachel Sinclair who has written the code for the iPCoD model with a specific query on iPCoD modelling for minke whale. Rachel stated via email (addressed to Stephanie Barnicoat dated Friday 21st November 2025): "*The minke whale PTS transfer functions in the iPCoD model are very old, very out of date and very highly conservative. Unfortunately, the effects of PTS on vital rates on minke whales were not included in the Booth & Heinis (2018) expert elicitation.* *I would suggest that until there is a revised expert elicitation on this topic for this species, that PTS for minke whales is not modelled in iPCoD*". With this in mind, the Applicant has undertaken modelling for minke whale using disturbance numbers only, presented in this chapter and included an over precautionary approach using SEL_{cum} PTS in a separate appendix with a written explanation why it is deemed over precautionary (see **Appendix 10.4 IPCoD Modelling Technical Report**).
66.	NatureScot	Written response to 2nd ETG 14 October 2025	At present, we advise that EDRs can be used for projects that do not currently have an established piling strategy / schedule publicly available and that the most precautionary EDRs for monopiles and pin-piles between	Acknowledged. This approach has been taken forward for assessing cumulative disturbance from piling in **Section 10.13.3.1.1**

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			the JNCC (2020) and JNCC (2025) papers should be used.	
67.	NatureScot	Written response to 2nd ETG 14 October 2025	**Do you agree with the assigned sensitivities?** Yes, we are content with the assigned sensitivities presented on slide 23.	All receptor sensitivities have been defined in **Section 10.12.1**.
68.	NatureScot	Written response to 2nd ETG 14 October 2025	In relation to Unexploded Ordnance (UXO), it isn't clear how disturbance from UXO clearance is proposed to be assessed. Slide 11 states '*Assessing PTS/TTS and disturbance from'* - for UXO's, we advise the use of TTS (temporary threshold shift) as a proxy for disturbance. This is because the noise is so short-term that displacement or other behavioural responses is unlikely. TTS is therefore the most likely worst case (sub-injury) consequence of this activity.	EDRs have also been used to assess for disturbance from UXO clearance in addition to TTS (see **Appendix 10.6 UXO Clearance Assessment on Marine Mammals and Leatherback Turtle**).
69.	NatureScot	Written response to 2nd ETG 14 October 2025	In general, apart from UXO clearance, we advise that TTS should not be used as a proxy for disturbance for assessing non-piling noise sources (pilling, geophysical survey, vessel noise etc.). If you wish to present TTS ranges alongside PTS ranges, we advise they should not be used in quantitative assessments of disturbance, except for UXO clearance.	TTS has not been used for any other impacts as a proxy to assess for disturbance.
70	NatureScot	Written response to 2nd ETG 06 February 2026	For the CEA, we advise that the UK portion of the MU should be used in the CEA. Just to avoid any confusion, for bottlenose dolphin, we do not recommend that the three MUs outlined (Offshore Waters, Coastal West Scotland Hebrides and Irish Sea) are combined and used as the reference population for iPCoD modelling in the CEA. Instead, we would advise that these should be assessed separately, which can be qualitatively based if necessary.	Acknowledged. For cumulative assessment, the CWSH and OW MU has been assessed separately (see **Section 10.13.3**). The Irish Sea (IS) MU has been screened out of the cumulative assessment due to the lack of sufficient evidence to demonstrate demographic or ecological connectivity between the IS and CWSH MUs. As a result, the IS MU was excluded from further consideration due to the limited availability of data on connectivity between the two units.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
71	NatureScot	Written response to 2nd ETG 06 February 2026	We are unclear as to why auditory based injury based on SPL_{peak} levels for minke whales are being included in iPCoD modelling. We advise that the potential for instantaneous injury should be minimised using mitigation measures to levels that would be considered negligible. Alternatively, justification should be provided in the EIA Report as to why mitigation measures are not sufficient to reduce the potential for instantaneous injury to negligible levels. We are content that SELcum PTS for minke whale is included as a separate appendix.	For minke whale, only disturbance numbers have been incorporated into the modelling due to the lack of expert elicitation or empirical data regarding PTS which is presented in **Sections 10.12.1.6.3.1.3** and **10.13.3.1.1.3.2.3**. Population modelling has been carried out using PTS (SEL_{cum} / $L_{E,p,t}$) as a precautionary approach and is presented in **Appendix 10.4 Interim Population Consequences of Disturbance (IPCoD) Modelling Technical Report**.

10.4 EXISTING DATA SOURCES

14. **Table 10.3** sets out the information and data sources that have been used to inform this chapter.

Table 10.3 Summary of key datasets and information sources

Dataset	Description	Citation / Application Document / Where Described
Distribution and abundance maps for cetacean species around Europe.	Desk based distribution and abundance data for the northeast Atlantic collected between 1980 and 2018 that has been used to characterise the marine mammal baseline.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.** Waggitt et al., 2019
Hebridean Whale and Dolphin Trust (HWDT) marine mammal survey data	Visual and PAM data collected between 2011 to 2024.	Presented in **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data.**
Identification of MPAs for minke whale (*Balaenoptera acutorostrata)*, Risso's dolphin (*Grampus griseus)*, white-beaked dolphin (*Lagenorhynchus albirostris)* and basking shark (*Cetorhinus maximus)*	Desk based data has been considered in baseline characterisation and the Report to Inform MPA Assessment. Data was collected summer seasons 2001 to 2012.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and the **Report to Inform MPA Assessment**. Paxton et al., 2014
Joint Cetacean Data Programme	Desk based data that will inform marine mammal baseline characterisation. In particular, regarding relevant species in the Inner and Outer Hebrides.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.** Joint Cetacean Data Programme (2024). *Data Standard: Core Data Fields and Vocabulary Guidance (Version 2.1).* JNCC, Peterborough, UK. DOI: https://doi.org/10.25607/OBP-1846.2
MUs for cetaceans in UK waters Inter-Agency Marine Mammal Working Group (IAMMWG)	Reference populations for the assessments.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** IAMMWG, 2023
NatureScot Research Report 1256- Aerial surveys of seals in Scotland	Data has been used for seal baseline characterisation.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Morris, et al., 2021
North Atlantic Marine Mammal Commission. (NAMMCO)	Desk-based literature to review abundance and population trends.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** NAMMCO (2022). *North Atlantic Marine Mammal Commission.* NAMMCO, Tromsø, Norway. Available at: https://nammco.no/

Dataset	Description	Citation / Application Document / Where Described
ObSERVE surveys	Acoustic and aerial surveys of marine mammals in Republic of Ireland waters collected between 2015 to 2017 from which density estimates for the assessment can be derived.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.** Paradell et al,. 2024
Organisation Cetacea (ORCA)	Desk-based data from the interactive map will be used for the marine mammal baseline.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** https://orca.org.uk/whale-dolphin-sightings
Persistent areas of high harbour porpoise densities.	Areas of high harbour porpoise densities in UK waters that have been used to characterise the marine mammal baseline.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.** Heinanen & Skov, 2015
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters	Data has been examined for relevant marine mammal species.	Hague et al., 2020; Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Hague et al., 2020
Revised Phase III data analysis of Joint Cetacean Protocol data resources	Data on cetacean abundances and distribution in the UK Exclusive Economic Zone (EEZ) from which density estimates for the assessment can be derived.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline.** Paxton et al., 2016
SCANS-III modelled densities	SCANS-III modelled densities estimates from 2016 survey used for review.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Lacey et al., 2022
Scotland's Marine Atlas	Desk-based data that has informed marine mammal baseline characterisation. In particular, regarding relevant species in the Inner and Outer Hebrides.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B. & Moffat, C.F. (eds.) (2011). *Scotland's Marine Atlas: Information for the National Marine Plan.* The Scottish Government, Edinburgh.
Sea of Hebrides proposed Marine Protected Area (MPA) survey	Desk based data of marine mammal sightings has been used for marine mammal baseline characterisation.	**Report to Inform MPA Assessment**. Webb et al. 2018
Sea Watch Foundation (public sightings)[1]	Public sightings data that is freely available online and which covers	Presented in **Appendix 10.2 Marine Mammal and Sea Turtles Baseline.**

[1] https://www.seawatchfoundation.org.uk/recentsightings/

Dataset	Description	Citation / Application Document / Where Described
	the Inner and Outer Hebrides, 2022, 2023 and 2025.	
Seal telemetry data	Data has been used for seal baseline characterisation.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Sharples et al., 2008; Russel and McConnell, 2014a
Seals at-sea relative density maps	Provides imagery of seal densities within the WDA.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Carter et al., 2022, Carter et al., 2025
Small Cetaceans in the European Atlantic and North Sea (SCANS)-IV data	Data on cetacean abundances and distribution in the North Sea and European Atlantic Ocean.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Gilles et al., 2023
Special Committee on Seals (SCOS) annual reporting of scientific advice on matters related to the management of seal populations	Data will be used for seal counts and pupping locations.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** SCOS, 2024
The Marine Protected Area Management and Monitoring and Collaborative Oceanography and Monitoring for Protected Areas and Species (COMPASS) projects	Array of acoustic monitoring data collected from 2017 to 2022 in western Scotland and Northern Ireland waters or published findings which will be used to characterise the marine mammal baseline.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle baseline** Edwards et al., 2020
Whale Dolphin Conservation (WDC) shore watch	Analysis of WDC Shorewatch Programme coastal cetacean sightings data, for the period 2005-2023.	Presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** Rodríguez-Mendoza et al 2025

10.5 SITE-SPECIFIC SURVEY DATA

15. In addition to the existing data sources identified in **Section 10.4**, the Project has undertaken site-specific surveys to inform the EIA (**Table 10.4**). Further details of the survey method are provided in Section 10.1 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**.

Table 10.4 Site-specific survey data

Dataset	Year(s)	Description
Third-party Digital Aerial Survey	2020 to 2021	DAS undertaken by APEM on behalf of a third-party developer across a portion of the OAA, including a 6 km buffer (see Plate 4.1 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**). Monthly surveys were actioned over 16 months from October 2020 to January 2022 inclusive.

Dataset	Year(s)	Description
Project's Digital Aerial Survey	2021 to 2023	DAS undertaken by APEM for the Project across the full OAA, including a 4 km buffer (analysed) and 6 km buffer, extending to 10 km during the survey (see Plate 4.2 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**). Monthly surveys were undertaken over 30 months from April 2021 to September 2023 inclusive.
Project's Marine Mammal Monitoring	2023	Visual and acoustic detections undertaken by the Project. Observations were taken from trained Marine Mammal Observers (MMO) / PAM operators during the Project's site investigation geophysical surveys, undertaken from August to November 2023 (Table 4.4 in see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).
Project's Marine Mammal Monitoring	2025	Visual and acoustic detections undertaken by the Project. Observations were taken from trained MMO / PAM operators during the Project's site investigation geophysical surveys, undertaken between April and July 2025.

10.5.1 The Project's Digital Aerial Survey Data

16. In order to provide site-specific and up to date information on which to base the impact assessment, a site-specific digital aerial survey was conducted for marine mammals and seabirds. APEM Limited collected high resolution digital aerial still imagery for marine megafauna (combined with ornithology surveys) over the MachairWind OAA plus 4 km and 6 km buffer, extending to a 10 km during the survey see Plate 4.1 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).

17. The aerial surveys captured images at 1.5 cm ground speed distance along 13 transect lines spaced approximately 3.2 km apart. The surveys started with a 4 km buffer from April to September 2021, a 6 km buffer from October 2021 to January 2022 and a 10 km buffer for the remaining surveys (February 2022 to September 2023). The buffer was extended for ornithology, and the data was banked in case it was required at a later date to assess for any potential impacts on birds. Therefore, for marine mammals, the current DAS results for the OAA plus a 4 km buffer have been used to calculate density estimates where relevant which is in line with NatureScot guidance advising a minimum of a 4 km buffer for DAS (NatureScot, 2023) (see Plate 4.1 in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).

10.6 MARINE MAMMALS AND LEATHERBACK TURTLE STUDY AREA

18. Section 2 of **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** describes the study areas used for the assessment.

10.7 REALISTIC WORST-CASE SCENARIOS

19. The final design of the WDA will be confirmed by detailed engineering studies post-consent. To undertake a robust and precautionary impact assessment, the realistic worst-case design scenarios (i.e., those that would cause the greatest impact) are defined from the Project Design Envelope; ensuring that all other design scenarios would have equal or less impact. Please see **Chapter 5 EIA Methodology** for further details on the design envelope approach.

20. The realistic worst-case scenarios for the marine mammal assessment are summarised in **Table 10.5** below. These are based on the project design as described in **Chapter 3 Project Description**.

Table 10.5 Realistic worst-case scenarios for impacts on marine mammals and leatherback turtle for activities in the WDA

Impact	Realistic Worst-Case Scenario	Rationale
Construction		
Impact 1: Underwater noise during geophysical surveys	A worst-case scenario of up to three geophysical survey vessels operating on site at any one time has been assumed for the assessment. These are expected to utilise the following equipment: • Sub Bottom Profiler (SBP); • Multi-beam echosounder (MBES); • Ultra-high resolution (UHR) Sparker • Ultra-Short Baseline (USBL); and • Side Scan Sonar (SSS).	The geophysical survey equipment is indicative only at this stage as it is unknown which specific noisy equipment will be utilised during geophysical surveys however these are based on the worst-case scenario. Prior to any geophysical survey, the full survey scope will be defined in the EPS licence application and EPS Risk Assessment (RA) which will be submitted to MD-LOT for approval.
Impact 2: Underwater noise during UXO clearance	A potential worst-case is UXO with a National Marine Fisheries Service (NEQ) of 750 kg (based on Natural England guidance (Parker et al., 2025)). Types and sizes of UXO: Various possible types and sizes of UXO, ranging from 0.25 kg to 750 kg. Underwater noise modelling and assessments include low-order deflagration with shaped charge of 0.25 kg NEQ. Underwater noise modelling and assessments are based on a worst-case high-order detonation of UXO with NEQ of 750 kg (including donor charge).	Low-order clearance would be the default method for UXO that require clearance. As a worst-case, assessments are based on high-order detonation in case there is an accidental detonation during a low order procedure. A detailed UXO survey will be completed prior to construction when a separate Marine Licence for UXO clearance will be submitted to MD-LOT for approval. The type, size and number of possible detonations and duration of UXO clearance operations is therefore not known at this stage. However, underwater noise during UXO clearance has been assessed in **Appendix 10.6 UXO Clearance Assessment on Marine Mammals and Leatherback Turtle** for information purposes.
Impact 3: Auditory injury from underwater noise during piling Impact 4: Disturbance and behavioural impacts from	Piling period 2030 Q2 to 2034 Q4 <u>Monopiles</u> • Maximum number of monopiles: 144 • Maximum pile diameter: 15 m • Maximum hammer energy: 6,600 kJ • Maximum number of monopiles installed per day: one • Maximum piling duration per monopile = 320 minutes • Maximum piling duration for maximum monopiles = 768 hours which = 32 days	The spatial worst-case scenario is based on the impact range for the maximum hammer energy required for the installation of monopiles. Maximum hammer energy is unlikely to be required on all piles but is assessed for all piles as a worst-case scenario.

Impact	Realistic Worst-Case Scenario	Rationale
underwater noise during piling	Pin-piles • Maximum number of pin-piles for WTGs: 576 • Maximum number of pin-piles for OSPs: 32 (16 per OSP) • Total number of pin-piles: 608 • Maximum pile diameter: 4.5 m • Maximum hammer energy: 4,400 kJ • Maximum number of pin-piles installed per day: six • Maximum piling duration per pin-pile = 195 minutes • Maximum piling duration for maximum pin-piles = 1976 hours which = 82.3 days	
Impact 5: Auditory injury and behavioural impacts from non-piling activities	Non-piling construction activities associated with seabed preparation and cable installation include: cable laying, suction dredging, drilling, rock placement and trenching. Offshore construction period: five years.	Results from the underwater noise modelling (see **Appendix 10.1 Underwater Nosie Modelling**) have estimated auditory impact ranges for marine mammals from non-piling activities. An assessment using these impact ranges is presented in **Section 10.12.1.7**.
Impact 6: Auditory injury and behavioural impacts from vessel noise	Maximum number of construction vessels operating at the WDA at any one time is 117. Total number of construction vessel round trips: 5699. There will be an average of 3 vessel transits between the selected construction port(s) and the WDA per day over the five-year offshore construction period.	Maximum number of construction vessels and construction vessel round trips include those required for export cable installation within the WDA and Offshore ECC so the assumptions are conservative.
Impact 7: Barrier effects due to underwater noise	As described for Impact 3 above.	A qualitative assessment is presented in **Section 10.12.1.9**. The maximum spatial area of effect is 10,237.5 km^2.
Impact 8: Vessel interaction (collision risk)	As described for Impact 6 above.	As described for Impact 6 above.
Impact 9: Disturbance at protected seal haul-out sites	See Impact 6. Closest seal haul-out site to the WDA is 12.5 km. Closest distance to an estimated vessel track is 2 km.	Disturbance to seal haul-out sites from piling is assessed in **Section 10.12.1.11.2.1**. An indicative list of ports for construction has been provided and an assessment for transiting vessels has been presented in **Section 10.12.1.8**.

Impact	Realistic Worst-Case Scenario	Rationale
Impact 10: Changes to prey availability	Temporary physical disturbance / habitat loss footprint within the WDA is 25,385,076 m^2. Increased suspended sediment concentrations (SSCs) and sediment re-deposition volume within the WDA is 20,251,431 m^3 (drilling and seabed preparation for foundations combined). See **Chapter 9 Fish (Including Basking Shark) and Shellfish**.	The worst-case scenario for marine mammals is based on the worst-case parameters and conclusions of the following assessments presented in **Chapter 9 Fish (Including Basking Shark) and Shellfish**: • Temporary physical disturbance / habitat loss; • Increased SSCs and sediment re-deposition; • Underwater noise and vibration; and • Changes in fishing activity.
Operation and Maintenance		
Impact 1: Underwater noise during geophysical surveys	Expected to utilise the following equipment • SBP; • MBES; • UHR; • USBL; and • SSS.	The geophysical survey equipment is indicative only at this stage as it is unknown which specific noisy equipment will be utilised during geophysical surveys however these are based on the worst-case scenario. Prior to any geophysical survey, an EPS RA and EPS licence will be submitted to MD-LOT for approval.
Impact 5: Auditory injury and behavioural impacts from non-piling activities	A programme of monitoring and scheduled maintenance would be undertaken throughout the lifetime of the Project to ensure that all WDA infrastructure is maintained in safe working order and to maximise operational efficiency. Underwater noise generating O&M activities include planned and unplanned maintenance and could include cable reburial/repair/replacement, suction dredging, drilling, rock placement and trenching.	Results from the underwater noise modelling report (see **Appendix 10.1 Underwater Noise Modelling**) have predicted auditory impact ranges for marine mammals, an assessment using these impact ranges is presented in **Section 10.12.1.7**. O&M activities will occur throughout the anticipated operational lifetime of the Project of 35 years. O&M activities would likely be concentrated in the summer months and would be sporadic and intermittent through the operational life of the Project.
Impact 6: Auditory injury and behavioural impacts from vessel noise	Indicative peak numbers of vessels on site at any one time during O&M: 13 Indicative annual vessel round trips during O&M: 423. An average of 1-2 vessels could be transiting to the WDA per day.	Results from the underwater noise modelling report (see **Appendix 10.1 Underwater Noise Modelling**) have predicted auditory impact ranges for marine mammals. An assessment using these impact ranges is presented in **Section 10.12.1.8.**
Impact 7: Barrier effects due to underwater noise	During the O&M phase of the project, marine mammals could be subject to barrier effects from the operational noise of WTGs. Maximum number of WTGs: 144.	The maximum spatial area and duration of potential impact would result in the worst-case barrier effect. The potential barrier effect during O&M would be less compared to the construction phase. A qualitative assessment is provided in **Section 10.12.1.9**.

Impact	Realistic Worst-Case Scenario	Rationale
Impact 8: Vessel interaction (collision risk)	As described above for O&M Impact 6.	An assessment has been carried out in **Section 10.12.1.10**.
Impact 9: Disturbance at protected seal haul-out sites	See Impact 6. Closest seal haul-out site to the WDA is 12.5 km. Closest distance to an estimated vessel track is 4.7 km.	Disturbance to seal haul-out sites from piling is assessed in **Section 10.12.2.9**. An indicative list of ports for O&M has been provided and an assessment for transiting vessels has been presented in **Section 10.12.1.8**.
Impact 10: Changes to prey availability	The worst-case scenario for marine mammals is based on the impact assessment parameters presented in **Chapter 9 Fish (Including Basking Shark) and Shellfish** for all possible effects on prey which should be referred to for detailed quantification of worst-case parameters: • Temporary physical disturbance / habitat loss; • Increased SSCs and sediment re-deposition; • Underwater noise and vibration; • Invasive Non-Native Species; • Changes in fishing activity; • Permanent habitat loss; • Electromagnetic fields (EMFs); and • Introduction of hard substrate.	The worst-case scenario for permanent habitat loss is the total seabed footprint of WDA infrastructure. Temporary physical disturbance / habitat loss during O&M would be from jack-up vessel activities, vessel anchoring and cable repair/replacement/reburial footprints. See **Section 10.12.1.12**.
Impact 11: Underwater Noise from operating WTGs	Auditory injury or disturbance from underwater noise generated from operating WTGs. Maximum number of WTGs: 144.	Results from the underwater noise modelling report (see **Appendix 10.1 Underwater Noise Modelling**) have predicted auditory impact ranges for marine mammals. An assessment using these impact ranges is presented in **Section 10.12.1.13**.
Decommissioning		
Impact 1: Underwater noise during geophysical surveys	The worst-case scenarios for decommissioning would be similar to those defined in the construction phase.	The impacts of decommissioning are primarily linked to the removal of infrastructure from the seabed, such as foundations, offshore cables and scour and cable protection. These activities may cause temporary disturbance to the seabed and increases Suspended Sediment Concentrations (SSCs) within the surrounding marine environment.
Impact 5: Auditory injury and behavioural		

Impact	Realistic Worst-Case Scenario	Rationale
impacts from non-piling activities		However, it is anticipated that the overall environmental impacts associated with decommissioning will be equal to, or potentially less than, those experienced during the construction phase. This is because there will be no requirement for piling and much of the WDA infrastructure will have already settled into place, and the removal process will likely be more controlled and less intrusive with respect to impacts on marine mammals. Additionally, any disturbance will be short-term and localised, with efforts made to minimise harm to marine mammals.
Impact 6: Auditory injury and behavioural impacts from vessel noise		
Impact 7: Barrier effects due to underwater noise		
Impact 8: Vessel interaction (collision risk)		
Impact 9: Disturbance at protected seal haul-out sites		
Impact 10: Changes to prey availability		

10.8 EXISTING ENVIRONMENT

10.8.1 Existing Baseline

21. **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** provide a detailed description of the baseline environment which is summarised in this section. Additionally, **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data** provides a wider context of marine mammal species' occurrence throughout the Hebrides.

22. Within the Wider Study Area (**Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**), the occurrence of 13 different marine mammal species has been identified to have a regular occurrence (Paxton et al., 2016; Gilles et al., 2023; Waggitt et al., 2019; SCOS, 2024, HWDT, 2025; Hague et al., 2020) plus one turtle species has been recorded in the Projects DAS and by the HWDT (HWDT, 2020):

- Toothed whales:
  - Harbour porpoise;
  - Bottlenose dolphin (*Tursiops truncatus)*;
  - Short-beaked common dolphin (*Delphinus delphis);*
  - Atlantic white-sided dolphin (*Lagenorhychus acutus*);
  - White-beaked dolphin;
  - Risso's dolphin*;*
  - Long-finned pilot whale (*Globicephala melaena);*
  - Killer whale (*Orcinus orca);*
- Baleen whales:
  - Minke whale*;*
  - Fin whale (*Balaenoptera physalus); and*
  - Humpback whale (*Megaptera novaeangliae)*.
- Pinnipeds:
  - Grey seal (*Halichoerus grypus*); and
  - Harbour seal (*Phoca vitulina)*.
- Turtles
  - Leatherback turtle (*Dermochelys coriacea)*

23. Of these, harbour porpoise, common dolphin, Risso's dolphin, white-beaked dolphin, grey seal and harbour seal are expected to be relatively common, while minke whale are seasonal visitors, and are commonly seen in the summer months. Common dolphin was the most abundant marine mammal species recorded in the Project's DAS as well as during the geophysical surveys.

24. Bottlenose dolphin, Atlantic white-sided dolphin, long-finned pilot whale, killer whale, and humpback whale are present in the area, but in lower numbers and are considered rare in the vicinity of the WDA.

25. Other cetaceans such as striped dolphin (*Stenella coeruleoalba)*, Cuvier's beaked whale (*Ziphius cavirostris)*, Northern bottlenose whale (*Hyperoodon ampullatus)*, fin whale and sei whale (*Balaenoptera borealis)* are found in deeper OW, and sightings in coastal waters of the west coast of Scotland are rare (HWDT, 2023). As fin whale was detected in the 2025 geophysical survey inside the WDA, it has been scoped in for assessment.

26. For some species, there is limited information available to inform a quantitative assessment, and therefore a qualitative assessment has been undertaken for:

- Humpback whale; and

- Leatherback turtle.

Table 10.6 Summary of marine mammal and leatherback turtle densities and reference population (in green) used for the assessment [= to be assessed qualitatively due to a lack of data]*

Species	Density (individuals / km²)	Density Data Source	Reference Population	Reference Population Data Source
Harbour porpoise	0.42 summer highest seasonal average	Project DAS (harbour porpoise data only)	UK: 24,305 (West Scotland (WS) MU) Total: 28,936 (WS MU)	IAMMWG (2023)
Bottlenose dolphin	0.0425	SCANS block CS-F (Gilles et al. 2023)	45 (Coastal West Scotland and the Hebrides (CWSH) MU) UK: 1,299 (Oceanic Waters (OW) MU) Total: 70,249 (OW MU)	IAMMWG (2023)
Common dolphin	0.80 summer seasonal average	Project DAS (common dolphin data only)	UK: 57,417 (Celtic Greater North Sea (CGNS) MU) Total: 102,656 (CGNS MU)	IAMMWG (2023)
Atlantic white-sided dolphin	0.0224	SCANS block CS-G (Gilles et al. 2023)	UK: 12,293 (CGNS MU) Total: 18,128 (CGNS MU)	IAMMWG (2023)
White-beaked dolphin	0.2543	SCANS block CS-G (Gilles et al. 2023)	34,025 (CGNS MU); Total: 43,951 (CGNS MU)	IAMMWG (2023)
Risso's dolphin	0.01	Project DAS (Risso's dolphin data only)	UK: 8,687 (CGNS) Total: 12,262 (CGNS MU)	IAMMWG (2023)
Killer whale	0.001	Waggitt et al. (2019) over SCANS block CS-F	15,014 (Northeast Atlantic (NA))	NAMMCO (2025)
			8 (West Coast community (WCC))	HWDT, (2025)
Long-finned pilot whale	0.0326	SCANS block CS-G (Gilles et al. 2023)	33,000 (NA)	Sea Watch Foundation (2025)
Minke whale	0.21 summer highest seasonal average	Project DAS (minke whale only)	UK: 10,288 (CGNS MU); Total: 20,118 (CGNS MU)	IAMMWG (2023)
Fin whale	0.002	Waggitt et al. (2019) over SCANS block CS-F	35,000 (NA)	HWDT, (2025)
Humpback whale*	No density available	-	-	-
Grey seal	0.88	Carter et al. (2025) over OAA plus 4 km buffer	WS MU: 17,447 Wider population: 51,471	SCOS (2024)

Species	Density (individuals / km^2)	Density Data Source	Reference Population	Reference Population Data Source
Harbour seal	0.08	Carter et al. (2022) over OAA plus 4 km buffer	WS MU: 19,707 Wider population: 31,627	SCOS (2024)
Leatherback turtle*	0.01 highest monthly density	Project DAS	No reference population available	

10.8.2 Predicted Future Baseline

27. Marine mammals throughout the west coast of Scotland and parts of Northern Ireland show varied but generally stable or improving trends (Cefas, 2024).

28. Coastal and shelf waters continue to support high densities of small cetaceans, including harbour porpoises, bottlenose dolphins and short-beaked common dolphins. Recent SCANS-IV findings confirm the continued presence of harbour porpoises and bottlenose dolphins in the Hebrides, where the latter form a small but stable population sensitive to disturbance (Gilles et al., 2023). Short-beaked common dolphins are expected to remain widespread and increasingly prominent in sightings as warming seas and shifting prey distributions drive further range expansion (Gilles et al., 2025). This pattern is consistent with the Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) Common Dolphin Group Report (2024), which identifies changes in foraging ecology and prey dynamics in the Malin Shelf region, indicating a growing presence in cross-border waters.

29. Atlantic white-sided dolphins are expected to remain concentrated in deeper OW, with stable populations near the Faroe Islands and WS (NAMMCO, 2023). In contrast, white-beaked dolphins may undergo range contractions as thermal habitats shift, with evidence showing a northward movement in response to increasing sea-surface temperatures (Gose et al., 2024). This research identifies emerging, distinct population groups across the NA and warns that white-beaked dolphins could disappear from waters around the UK and Ireland due to climate-driven habitat loss, an outcome supported by long-term strandings data showing a northward shift in occurrences (IJsseldijk et al., 2018).

30. Risso's dolphins are expected to occur more frequently around the Hebrides, particularly near the Isle of Lewis, where long-term observations have recorded repeated sightings and mother–calf pairs, indicating site fidelity and habitat importance (WDC, 2024; Gilles et al., 2025). Long-finned pilot whales are also likely to remain associated with deeper waters, although future distribution may be influenced by naval sonar activity and climate variability. While they exhibit high thresholds for sonar avoidance, suggesting resilience, they are not immune to disturbance (Antunes et al., 2014). Climate-driven changes in squid distribution may further affect their range (NOAA Fisheries, 2024). The critically endangered WCC of killer whales is projected to continue declining, with only eight individuals remaining and no calves recorded for decades. This population is considered functionally extinct due to persistent reproductive failure linked to high Polychlorinated Biphenyls contaminant loads and extremely small population size. Without new individuals or successful breeding, extinction is expected within the coming decades. Although conservation measures focus on monitoring and reducing threats such as chemical pollution and vessel disturbance, these actions cannot reverse the underlying genetic bottleneck

31. Among baleen whales, minke whales are expected to remain the most frequently sighted species, supported by stable populations and productive feeding grounds. In 2023, the HWDT reported their highest sighting rate in 20 years, recording 167 individuals (HWDT, 2024; InsideEcology, 2024). Fin whales are predicted to increase in deeper Hebridean waters as NA populations recover (International Whaling Commission (IWC), 2015). Humpback whales are also likely to continue their long-term resurgence, with increasingly frequent winter sightings and around ten new individuals identified annually. Many matches link Hebridean humpbacks to Icelandic populations, indicating these are migratory visitors rather than resident whales (HWDT, 2024). For pinnipeds, grey seal numbers are projected to continue increasing, with SCOS (2024) reporting ongoing growth in pup production across western Scotland and the Western Isles. Harbour seals show more variable trends: west coast populations may stabilise or grow modestly, while declines in Northern Ireland may persist due to disease and habitat pressures (SCOS, 2024). Seasonal visitors such as leatherback turtles are expected to remain rare but present, with sightings peaking in late summer. Long-term evidence nevertheless points to continued declines in UK waters, although Irish foraging areas remain important within their wider range (Celtic White Sea Report; OSPAR, 2007).

10.8.3 Data Limitations and Assumptions

32. There is a good level of knowledge of the baseline environment due to the large amount of available data and information that has been reviewed for marine mammals within the region, including the site-specific surveys. However, with the Project's DAS, there are limitations, primarily due to the highly mobile nature of marine mammals and leatherback turtle, and therefore the potential variability in usage of the OAA. Other limitations include that the monthly DAS surveys only provide a 'snapshot' of the area both spatially and temporally. If any marine mammal or leatherback turtle is submerged, they may not be detected. However, this limitation is offset by the application of a correction factor.

33. The majority of the surveys, such as the SCANS, are typically carried out in summer months, which can result in seasonal gaps. However, the Project's DAS were conducted every month over a 30-month survey period (greater than the 24 months of survey data required by NatureScot), with all data analysed (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**). Additionally, third-party data has been used to provide further site context (**Section 10.5** and **Appendix 10.2**). Therefore, there is good data coverage to provide information on the species likely to be present throughout the Study Area and the Wider Study Area.

34. Waggitt et al. (2019) emphasise that their distribution maps should only be used to illustrate the general, broad-scale distribution of species. Using these densities for fine-scale distributions should be avoided because:

- Small and isolated sub-populations have very little influence on models, such as white-beaked dolphins in southwest England and Risso's dolphins in North Wales / Isle of Man (IoM);
- Substantial changes in harbour porpoise movements from north to south in the North Sea took place across the study period;
- Seasonal movements were detected by the modelling but have not produced changes in seasonal changes in densities; and
- The densities for bottlenose dolphins represent the offshore ecotype only, excluding regionally important inshore populations (e.g. CWSH MU).

35. While the Waggitt et al. (2019) data has been used, to allow a more accurate comparison of the species densities across the different datasets, the average for seasonal and annual periods across the area of the SCANS block CS-F where the WDA is located have been calculated for each species (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**). For species with no density estimate in the SCANS CS-F block, an adjacent SCANS block has been used (e.g. for long

finned pilot whale). If that is not an option, Waggitt et al. (2019) data has been overlaid over the SCANS CS-F block to calculate an estimated density of marine mammals (e.g. killer whale and fin whale).

36. All marine mammal and leatherback turtle densities are presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline** and summarised in **Table 10.6**. As a precautionary approach, unless otherwise agreed with NatureScot, density estimates used in the assessments for each receptor are based on the most precautionary density estimate, from a range of available data sources. These densities were agreed through the consultation process (**Table 10.6**).

10.9 DESIGNATED SITES

37. Designated sites considered within the marine mammals and leatherback turtle chapter are summarised in **Table 10.7** The WDA does not overlap any designated sites; however, it is located within 0.4 km of the Inner Hebrides and the Minches Special Area of Conservation (SAC) and within 4.3 km of the Sea of the Hebrides NCMPA.

38. As shown in **Table 10.7**, each marine mammal population of any designated site are part of a wider population, given the wide-ranging and highly mobile nature of marine mammals. Therefore, any effects on a particular designated site population are based on the assessment for the wider population.

39. Potential impacts on designated sites within the UK Site Network, comprising of SACs and Special Protection Areas (SPAs) designated under domestic legislation transposing the EC Habitats Directive (92/43/EEC) and Birds Directive (2009/147/EC), are assessed through the HRA process. Accordingly, potential effects on marine mammal SACs are assessed within the **RIAA**, which accompanies this EIAR.

40. NCMPAs are designated under different legislation, the Marine (Scotland) Act 2010 and associated Orders, and are therefore considered separately from SACs and SPAs. Under the 2010 Act, public authorities have a duty not to authorise activities unless it can be demonstrated that there is no significant risk of hindering the achievement of the conservation objectives of an NCMPA (Section 83(4)). Consequently, the assessment of potential impacts on the Sea of the Hebrides NCMPA is provided alongside this EIAR (see the **Report to Inform Marine Protected Area Assessment**).

Table 10.7 Designated sites and qualifying features relevant to the marine mammal and leatherback turtle assessments

Designated Site	Qualifying feature(s)	Relevant wider population	Closest distance from Windfarm Development Area (WDA) (km)
Inner Hebrides and the Minches SAC	Harbour porpoise	24,305 (WS MU)	0.4
Skerries and Causeway SAC			68
Sea of Hebrides NCMPA	Minke whale	2,458 (WS area (Figure 5.1 of **Report to Inform Marine Protected Area Assessment**))	4.3
Treshnish Isles SAC	Grey seal	50,199 (WS, Southwest Scotland, Western Isles and Northern Ireland MUs, with the Republic of Ireland (see Plate 7.3 of the **Appendix 10.2**	40

Designated Site	Qualifying feature(s)	Relevant wider population	Closest distance from Windfarm Development Area (WDA) (km)
		Marine Mammals and Leatherback Turtle Baseline))	
South-East Islay Skerries SAC	Harbour seal	33,060 ((WS, Southwest Scotland, Western Isles and Northern Ireland MUs, with the Republic of Ireland (see Plate 7.3 of the **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**))	66.5
Eileanan agus Sgeiran Lios mor SAC			77
Sound of Barra SAC			100
Ascrib, Isay and Dunvegan SAC			175

10.10 EMBEDDED MITIGATION

41. This section outlines the embedded mitigation relevant to the marine mammal assessment (as shown in **Table 10.8** below). Where additional mitigation measures are required to mitigate potentially significant effects (in EIA terms), these are detailed in the impact assessment.

Table 10.8 Embedded mitigation measures for marine mammals

I.D.	Mitigation Measure	Description	Securing Mechanism
M-4	Environmental Management Plan	Development of, and adherence to, an Environmental Management Plan (EMP) which will be in accordance with **Appendix 6 Outline EMP** submitted with the application for section 36 consent and marine licences. This will utilise current good practice for all activities to reduce the risk of collisions and disturbance with marine mammals and basking shark. Vessel movements, where possible, will follow set vessel routes and hence areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk and disturbance. All vessel movements will be kept to the minimum number that is required so that any potential collision risk and disturbance is further reduced. Additionally, vessel operators will use good practice to reduce any risk of collisions and minimise disturbance to marine mammals and basking shark, including compliance with the Scottish Marine Wildlife Watching Code[2]. Also, the Project's Environmental Clerk of Works will ensure vessel crew (where applicable) are informed of the locations of the protected seal haul-out sites.	Section 36 and marine licence consent conditions. Secured via **Appendix 6 Outline EMP**.

[2] https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20(A2263518).pdf

I.D.	Mitigation Measure	Description	Securing Mechanism
M-6	Piling Noise Mitigation Plan	JNCC (2010) guidelines for minimising the risk of injury to marine mammals from piling noise and JNCC guidance for the use of PAM in UK waters for minimising the risk of injury to marine mammals from offshore activities are outlined in Section 4 of **Appendix 9 Draft MMMP** submitted with the application. A Piling Noise Mitigation Plan will be developed in the preconstruction phase in accordance with Section 4 of **Appendix 9 Draft MMMP**.	Section 36 and marine licence consent conditions. Secured via **Appendix 9 Draft MMMP** which sets out the requirements for a Piling Noise Mitigation Plan.[3].
M-7	Marine Pollution Contingency Plan (MPCP)	Development of, and adherence to, a MPCP. The MPCP will provide guidance to the Project personnel, contractors and subcontractors on the actions and reporting requirements in the event of spills and collision incidents. The MPCP will also contain emergency plans and mitigation procedures for a range of potential marine pollution incidents.	Section 36 and marine licence consent conditions. Secured via **Appendix 7 MPCP**.
M-8	Cable Plan	Development of, and adherence to, a Cable Plan (incorporating a Cable Burial Risk Assessment (CBRA)). The Cable Plan will confirm planned cable routeing, burial, and any additional external cable protection, and will set out methods for post-installation cable monitoring. Furthermore, this plan will detail environmental sensitivities and design considerations to mitigate, as far as practicable, the effects of offshore cable laying and associated protection during installation and operation of the WDA infrastructure. The amount of cable protection utilised will be minimised where practicable; protection will be used only where design burial depths are not achievable or where crossings require it.	Section 36 and marine licence consent conditions. Secured via the requirement for a Cable Plan, to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
M-11	UXO clearance	A detailed MMMP based on JNCC (2025a) guidelines for minimising the risk of injury to marine mammals from UXO, and Marine licensing – UXO application guidance (Marine Directorate, 2025), on minimising environmental impacts from UXO clearance, will be included in the Final MMMP prepared for UXO clearance during the pre-construction phase. The Final MMMP will accord with **Appendix 9 Draft MMMP** submitted with the application. This will ensure there are adequate mitigation measures to minimise the risk of any physical or permanent auditory injury to marine	Mitigation will be secured in the UXO MMMP[3] as part of a separate Marine Licence application submission prior to construction.

[3] Note that **Appendix 9 Draft MMMP** covers mitigation for geophysical surveys, UXO clearance and piling, however, each of these activities will be split out post-consent into their own separate MMMPs as required (any geophysical survey mitigation plans will be included in the relevant EPS licence applications, a MMMP for UXO clearance will be included in a separate Marine Licence application for UXO clearance, and a MMMP for piling will be included within the Piling Noise Mitigation Plan to be produced post-consent as per MD-LOT guidance).

I.D.	Mitigation Measure	Description	Securing Mechanism
		mammals from UXO clearance. Following the latest guidance, low order clearance will be the default method. The Draft MMMP for UXO clearance is presented in Section 3 of **Appendix 9 Draft MMMP**.	
M-12	Geophysical surveys	JNCC (2017) guidelines for minimising the risk of injury to marine mammals from geophysical surveys will be followed. See section 2.2 of the **Appendix 9 Draft MMMP**.	Mitigation will be secured in the EPS licence(s)[3].
M-46	Decommissioning Programme	Development and adherence to a Decommissioning Programme. This programme will identify all the items of equipment, infrastructure and materials that have been installed or drilled and describes the decommissioning solution for each whilst considering the potential environmental effects of each method alongside appropriate mitigation techniques that can be implemented.	Section 36 and marine licence consent conditions. Secured via a Decommissioning Programme, which will be developed and submitted to Scottish Ministers for approval before commencement of construction.
M-47	Construction Method Statement	Development of, and adherence to, a Construction Method Statement (CMS), to set out good working practices during construction. This will include a clear outline of roles and responsibilities and reference to health and safety protocols. The CMS will outline how the construction programme is adaptable to adverse weather.	Secured in the Section 36 consent and Marine Licence via the requirement for a CMS, which will be developed and submitted to Scottish Ministers for approval before commencement of construction.

10.11 APPROACH TO ASSESSMENT

42. As noted above, this topic chapter considers the WDA Study Area and existing environment only. A combined assessment of the construction, O&M and decommissioning of the WDA activities, Offshore ECC and OnTDA activities (commensurate with the level of detail that is available at the time of carrying out that assessment) is also provided and the methodology for this is described in **Section 10.11.2**. This approach will ensure a holistic view is undertaken of the entire Project.

10.11.1 Windfarm Development Area-Alone

10.11.1.1 Methodology

43. **Chapter 5 EIA Methodology** provides a summary of the general impact assessment methodology applied in this WDA EIAR. The assessment uses the conceptual 'source-pathway-receptor' model. The model identifies potential impacts resulting from the proposed activities on the environment and sensitive receptors within it.

10.11.1.2 Definitions of Sensitivity and Magnitude

44. The characterisation of the existing environment helps to determine the receptor sensitivity to assess the potential impacts upon it.

45. Sensitivity is defined with regard to the ability of a receptor to adapt to change, tolerate, and/or recover from potential effects (**Table 10.9**).

46. The sensitivity level of marine mammals to each type of impact is justified within the impact assessment and is dependent on the following factors:

- **Adaptability** – The degree to which a receptor can avoid or adapt to an impact;
- **Tolerance** – The ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
- **Recoverability** – The temporal scale over and extent to which a receptor will recover following an impact; and
- **Value** – A measure of the receptor importance, rarity and worth.

Table 10.9 Definition of sensitivity levels for marine mammal receptors

Sensitivity	Definition
High	Individual receptor has very limited or no capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to accommodate, adapt to or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

47. In addition, for some assessments the 'value' of a receptor may also be an element to add to the assessment where relevant – for instance if the receptor is designated or has an economic value.

The 'value' of a receptor is a key consideration in the assessment. Protected species or habitats are generally assigned higher value than those without formal protection. However, value and sensitivity are not inherently linked: a receptor may be of high value but exhibit low or negligible physical or ecological sensitivity to a particular effect, while a lower-value receptor may still be highly sensitive. Sensitivity is therefore evaluated on a receptor-specific basis. Most marine mammal species are protected under multiple international agreements, as well as European and UK legislation and policy. All cetaceans in UK waters are classified as EPS and are therefore considered internationally important. In addition, species such as harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal benefit from further protection through designated sites. On this basis, all marine mammal species are considered to be of high value.

48. **Table 10.10** provides definitions for the value afforded to a receptor based on its legislative importance. The value will be considered, where relevant, as a modifier for the sensitivity assigned to the receptor, based on professional judgement.

Table 10.10 Definition of the value levels for marine mammal and leatherback turtle receptors

Value	Definition
High	Internationally or nationally important. Internationally or nationally protected species that are listed as a qualifying interest feature of an internationally or nationally protected site (i.e. Annex II protected species designated

Value	Definition
	feature of a designated site) and protected species (including EPS) that are not qualifying features of a designated site.
Medium	Regionally important or internationally rare. Protected species that are not qualifying features of a designated site but are recognised as a Biodiversity Action Plan (BAP) priority species either alone or under a grouped action plan and are listed on the local action plan relating to the Study Area.
Low	Locally important or nationally rare. Protected species that are not qualifying features of a designated site and are occasionally recorded within the Study Area in low numbers compared to other regions.
Negligible	Not considered to be particularly important or rare. Species that are not qualifying features of a designated site and are never or infrequently recorded within the Study Area in very low numbers compared to other regions.

49. Determining the magnitude of an impact considers several factors, including:

- Type of impact: would the impacts of the activity be permanent, long-term, or temporary;
- Duration and frequency of the activity;
- Extent of the activity; and
- Timing and location of the activity.

50. There were no agreed thresholds to determine magnitude for marine mammals at the time of writing. The thresholds for defining the potential magnitude of impact that could occur from a particular impact will be determined using professional judgement, current scientific understanding of marine mammal population biology, and the draft guidance on disturbance to EPS species by JNCC et al. (2010) and the Marine Scotland (2020) Guidance for Scottish Inshore Water for the protection of Marine EPS from injury and disturbance. This guidance suggests definitions for a 'significant group' of individuals or proportion of the population for EPS species. Consequently, this guidance has been considered in defining the thresholds for magnitude of impact (**Table 10.11**).

51. The JNCC et al. (2010) draft provides some indication on how many animals may be 'removed' from a population without causing detrimental effects to the population at favourable conservation status (FCS). It also provides limited consideration of temporary effects, with guidance reflecting consideration of permanent displacement.

52. As agreed with NatureScot, temporary effects are considered to be of medium magnitude at greater than 5% of the reference population. JNCC et al. (2010) draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the 'default' rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth halted. In assigning 5% to a temporary impact in this assessment, consideration is given to uncertainty of the individual consequences of temporary disturbance.

53. Permanent effects with a greater than 1% of the reference population being affected within a single year are considered to be high in magnitude in this assessment. This is based on ASCOBANS and the Defra advice relating to impacts from fisheries by-catch (i.e. a permanent effect) on harbour porpoise. A threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to ASCOBANS, with an intermediate precautionary objective of reducing the impact to <1% of the population (Defra, 2003; ASCOBANS, 2015). To determine the magnitude of an impact for any quantitative impact assessments, the number of

individuals that could be impacted is put into the context of the relevant reference population (based on the definitions of magnitude shown in **Table 10.11**). For all assessments where the results show that more than one individual is at risk, the number has been rounded up to a whole number to ensure the result of the assessment is biologically relevant.

Table 10.11 Definition of the magnitude levels for marine mammal receptors

Value	Definition	Criteria for Quantitative Assessments	
		Approximate Duration of Effect	**% of Ref. Pop. Exposed to Effect**
High	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short-to-long term and to alter the long-term viability of the population and / or the integrity of the protected site. The effect, which may be either reversible or irreversible in individuals, would be of sufficient severity to affect the long-term viability of the relevant population.	Permanent[4]	> 1%
		Long-term[5]	>5%
		Temporary[6]	>10%
Medium	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and / or the integrity of the protected site. The effect, which may be either reversible or irreversible in individuals, could result in some population-level effects, but not a level that would alter the relevant population trajectory.	Permanent	0.01% - 1%
		Long-term	1% - 5%
		Temporary	5% - 10%
Low	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature / population. Whilst there may be effects at an individual level which may be either reversible or irreversible, these would not be at a scale that would lead to any population-level effects.	Permanent	0.001% - 0.01%
		Long-term	0.01% - 1%
		Temporary	1% - 5%
Negligible	Very slight change from the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Effects are likely to be reversible and highly unlikely to result in any population-level effects.	Permanent	< 0.001%
		Long-term	< 0.01%
		Temporary	< 1%

[4]Permanent: Impacts of any duration leading to lasting effects.
[5]Long-term: Impacts are expected to occur throughout the lifetime of the development either continuously or intermittently with recoverable effects.
[6]Temporary: Impacts lasting a short duration and/or occurring intermittently with recoverable effects.

Value	Definition	Criteria for Quantitative Assessments	
		Approximate Duration of Effect	% of Ref. Pop. Exposed to Effect
No change	No loss of, or gain in, size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site.	N/A	N/A

10.11.1.3 Significance of Effect

54. The potential significance of effect for a given impact is a function of the overall sensitivity and the magnitude of the impact (see **Chapter 5 EIA Methodology** for further details). A matrix is used (**Table 10.12**) as a framework to determine the significance of an effect. Definitions of each level of significance are provided in **Table 10.13**. Impacts and effects may be either positive (beneficial) or negative (adverse). Impacts or beneficial effects that are moderate or major are generally considered to be significant in EIA terms.

55. In applying this methodology, professional judgement contributes to concluding significance of effects. This judgement draws on the assessor's technical expertise, knowledge of the receiving environment, and understanding of how similar developments have influenced comparable receptors. Judgement also considers the quality and confidence of the available data (**Section 10.8.3**), the level of uncertainty associated with predicted impacts, and any relevant guidance or industry standards. Professional judgement ensures that the matrix outputs are interpreted in context, allowing the assessor to account for site-specific conditions, receptor sensitivities that may cut across criteria, and the nature of the predicted changes. This approach ensures that the determination of significance is robust, transparent and proportionate.

56. Potential effects are described, followed by a statement of whether the effect is significant in terms of the EIA regulations. Potential effects identified within the assessment as major or moderate are regarded as significant in terms of the EIA regulations. Whilst minor effects (or below) are not significant in EIA terms, it is important to distinguish these, as they may contribute to significant effects cumulatively or through interactions. Each impact has been considered using a range of assessment methods, including quantitative and qualitative methods, and has taken into account the effects of each impact over the project lifetime. Consequently, the overall significance has regard to the full evidence base. Following initial assessment, if the effect does not require additional mitigation (or none is available whilst meeting the Project's objectives), the residual effect would remain the same. If, however, additional mitigation is proposed, an assessment of the post-mitigation residual effect is provided.

57. Further assessment, including population modelling using iPCoD, has been undertaken for piling at the marine mammal MU and SAC level (presented in the RIAA), where relevant. Natural Resource Wales (NRW) guidance (2023) states that if, as a result of PTS, a population shows a continued decline of >1% per year (versus a modelled unimpacted reference population) over a set period of time (e.g., the first six years, based on the former FCS reporting period), then there is a high likelihood that a significant effect cannot be ruled out. NRW have acknowledged that this threshold could be used as one possible method to determine the significance of behavioural disturbance on a population, based on the iPCoD outputs. However, this guidance is intended for consideration of PTS and remains under development. In absence of other guidance, the 1% threshold for iPCoD outputs remains a valid way to inform overall significance of effect and therefore this approach has been used in the assessments.

Table 10.12 Significance of effect matrix

Sensitivity	Adverse Magnitude				No Change	Beneficial Magnitude			
	High	Medium	Low	Negligible	No Effect	Negligible	Low	Medium	High
High	Major	Major	Moderate	Minor	No Effect	Minor	Moderate	Major	Major
Medium	Major	Moderate	Minor	Negligible	No Effect	Negligible	Minor	Moderate	Major
Low	Moderate	Minor	Minor	Negligible	No Effect	Negligible	Minor	Minor	Moderate
Negligible	Minor	Negligible	Negligible	Negligible	No Effect	Negligible	Negligible	Negligible	Minor

Table 10.13 Definition of significance of effect

Significance of Effect	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No Change	No effect, therefore, no change in receptor condition.

10.11.2 Combined Assessment: Windfarm Development Area, Offshore Export Cable Corridor and Onshore Development Transmission Development Area Methodology

58. This section presents how the Applicant will assess interactions between the WDA, Offshore ECC and OnTDA (i.e. considering impact interactions and additive effects to determine if any effects would be materially elevated from those assessed for the WDA-alone assessment). The approach enables potential interactions between each Development Area to be identified and assessed, ensuring a whole Project assessment is undertaken in a manner that is meaningful and proportionate. This is referred to as the combined assessment.

59. In this context, interactions are considered where there may be spatial overlap of effects and additive effects are considered where there may be incremental effects on the same receptor, including increased temporal effects.

60. Worst-case scenarios for all WDA infrastructure (which includes OSPs, OSP link cables and up to 200 km of the offshore export cable(s) which could be located within the WDA red line boundary) has been incorporated into the worst-case scenario for the WDA-alone assessment (**Table 10.5** and **Section 10.12.1**).

61. The combined assessment is based on a broad preliminary Offshore ECC that connects the WDA to a landfall location(s) near Girvan, South Ayrshire. Section 3.7 in **Chapter 3 Project Description** details indicative parameters relating to project components and associated construction methods

and timelines which have informed the combined assessment. Offshore and onshore engineering and environmental surveys enabling Offshore ECC and OnTDA corridor refinement are anticipated to take place after the WDA EIAR has been submitted to the consenting authorities.

62. Within the upcoming Offshore ECC and OnTDA consenting applications, their respective scoping and EIARs will take account of all likely effects predicted within the WDA EIA and present updated combined assessments using the latest available information covering all aspects of the Project.

63. **Section 10.12.2** includes a qualitative discussion where potential interactions and additive effects between the WDA and the Offshore ECC and OnTDA have been identified, with the aim of determining whether effects could result in those of greater significance than assessed for the WDA-alone assessment. To accompany the description, a combined assessment summary table is provided. Only residual effects from the WDA-alone assessment are taken forward for consideration in the combined assessment.

10.11.3 Cumulative Effects Assessment Methodology

64. The CEA considers the impacts arising from the activities and infrastructure associated with the whole-Project (i.e. the WDA, Offshore ECC and OnTDA) as well as cumulatively with other relevant plans, projects and activities. The general approach to the CEA for the marine mammal and leatherback turtle chapter includes identifying potential cumulative effects, identifying a short list of plans and projects for consideration and evaluating the significance of cumulative effects. **Chapter 5 EIA Methodology** provides further details on the general approach to the CEA.

65. In line with the methodology set out in **Chapter 5 EIA Methodology**, the CEA is considered in two main stages with stage 1 split into two steps:

- **Stage 1a**: Screening of Potential Cumulative Impacts;
- **Stage 1b**: Screening of other plans, projects and activities; and
- **Stage 2**: CEA.

66. All projects follow the same staged approach to cumulative assessment.

- Stage 1a involves screening to identify which whole-Project impacts could give rise to cumulative effects with other plans, projects, and activities ('impact screening').
- Stage 1b then screens the other plans, projects, and activities themselves.

67. In line with the guidance outlined in **Chapter 5 EIA Methodology**, any other plans or projects that are underway or reasonably likely to occur, and for which sufficient information exists, are taken forward for consideration within **Appendix 10.5 Cumulative Effects Assessment (CEA) Screening**. It was agreed through consultation that a six-month cut off prior to EIA submission for data of projects screened into the CEA (See **Table 10.2**).

68. Projects are included if they fall into any of the following categories:

- Operational since baseline data were collected (April 2021);
- Under construction (between 2030 to 2035);
- Permitted but not yet implemented;
- Submitted but not yet determined;
- Reasonably foreseeable projects (*operational after April 2021, or construction in 2030 to 2035),* including:
    - Projects in Scottish waters;
    - Projects in English, Welsh, Northern Irish, or relevant non-UK waters where connectivity or cumulative effects may occur;

- Any project that has submitted a Scoping Report up to six months prior to submission of the WDA application (November, 2025);
- Offshore wind projects granted an Option or Agreement for Lease;
- Non-wind projects with potential for cumulative effects.

69. **Appendix 10.5 Cumulative Effects Assessment (CEA) Screening** has been developed based on the above criteria, with the list of projects being screened for each potential impact-receptor pathway using the following process:

- **Conceptual overlap**: an impact-receptor pathway describes an impact which has the potential to directly or indirectly affect the receptor(s) in question;
- **Physical overlap**: ability for impacts arising from the WDA, Offshore ECC and OnTDA to overlap with those from other plans or projects on a receptor basis. An overlap of the Zone of Influences (ZoIs) arising from the two (or more) projects/plans must be established for a cumulative effect to arise. There are exceptions to this for certain mobile receptors that are potentially subject to impacts from multiple plans or projects; and
- **Temporal overlap**: for a cumulative effect to arise from two or more plans or projects, a temporal overlap of impacts arising from each must be established. Some impacts are active only during certain phases of the WDA (e.g. piling noise during construction). However, the absence of a strict overlap may not necessarily mean there is no potential for cumulative effect, as receptors may become further affected by additional, non-temporally overlapping projects.

70. Stage 2 is the assessment of cumulative effects. A tiered approach is used to provide a framework for placing relative weight on the potential for each plan or project to be included in the CEA, based on the plan's or project's current stage of maturity, certainty in the design or effects and overall availability of detail on which to carry out an assessment. Projects or plans that will be assessed in Stage 2 will use the following tiers:

- Tier 1 assessment: projects which are operational (but not part of the baseline), under construction, those with consent and those projects where an application has been submitted but not yet determined;
- Tier 2 assessment: all plans/projects assessed under Tier 1, plus those projects with a Scoping Report and/or Scoping Opinion; and
- Tier 3 assessment: all plans/projects assessed under Tier 1 and Tier 2, plus those projects likely to come forward where a Crown Estate Scotland (CES) Option to Lease Agreement or equivalent has been granted (i.e., ScotWind and Innovation and Targeted Oil & Gas projects).

10.11.4 Transboundary Effects Assessment Methodology

71. The transboundary effect assessment considers the potential for effects to occur as a result of the WDA on marine mammal receptors within the EEZ of other European Economic Area (EEA) member states or other interests of EEA member states. **Chapter 5 EIA Methodology** provides further details on the approach to the transboundary effect assessment.

72. For marine mammals, the potential for transboundary effects has been identified in relation to the reference MUs and potential linkages to other countries (for example, as identified through seal telemetry studies). Further information on transboundary effects is outlined in **Section 10.14**.

10.12 ASSESSMENT OF SIGNIFICANCE

10.12.1 Windfarm Development Area-Alone Assessment of Significance

73. The potential effects on marine mammal and leatherback turtle receptors that may occur during construction, operation and decommissioning of the WDA are assessed in the following sections.

The assessment follows the methodology set out in **Section 10.11.1** and is based on the realistic worst-case scenarios defined in **Section 10.7**. Due to the nature of the underwater noise modelling and associated quantitative assessments (e.g. auditory injury and disturbance), not all embedded mitigation measures are incorporated at the outset of the modelling. For impact piling, a precautionary soft-start and ramp-up procedure is included within the modelling; however, mitigation measures such as MMO; PAM and ADD are not. In these instances, embedded mitigation measures identified in **Section 10.10** that are not accounted for quantitatively are subsequently considered qualitatively to re-evaluate the magnitude of impact and determine the significance of the effect.

74. Therefore, the assessment has been undertaken without embedded mitigation incorporated into the initial quantitative modelling (except soft-start and ramp-up) however is subsequently considered qualitatively on the basis of all embedded mitigation measures outlined in **Table 10.8**. The embedded mitigation measures relevant to each impact are listed in the summary **Table 10.84**.

10.12.1.1 Sensitivity of Receptors

75. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14.** Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

Table 10.14 Receptor sensitivity for the WDA alone, combined assessment and CEA

Receptor	Sensitivity										
	PTS from impulsive noise (geophysical surveys / piling / UXO clearance)	**TTS from impulsive noise (geophysical surveys / piling / UXO clearance)**	**Auditory injury from non-impulsive noise (non-piling activities / vessels)**	**Disturbance from underwater noise (impulsive and non-impulsive activities)**	**Auditory injury from operational WTGs**	**Disturbance from operational WTGs**	**Disturbance from the presence of vessels**	**Barrier effects due to underwater noise**	**Collision risk from vessels**	**Disturbance to seal haul out sites**	**Changes to prey availability**
Harbour porpoise	High	Medium	Medium (high for PTS)	Medium	Medium	Low	Medium	Medium	Low	N/A	Medium
Bottlenose dolphin	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
Common dolphin	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
Atlantic white-sided dolphin	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
White-beaked dolphin	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
Risso' dolphin	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
Killer whale	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low
Long-finned pilot whale	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low

Receptor	Sensitivity										
	PTS from impulsive noise (geophysical surveys / piling / UXO clearance)	**TTS from impulsive noise (geophysical surveys / piling / UXO clearance)**	**Auditory injury from non-impulsive noise (non-piling activities / vessels)**	**Disturbance from underwater noise (impulsive and non-impulsive activities)**	**Auditory injury from operational WTGs**	**Disturbance from operational WTGs**	**Disturbance from the presence of vessels**	**Barrier effects due to underwater noise**	**Collision risk from vessels**	**Disturbance to seal haul out sites**	**Changes to prey availability**
Minke whale	High	Medium	Medium (high for PTS for non-piling activities)	Medium	Medium	Low	Medium	Medium	Medium	N/A	Medium
Fin whale	High	Medium	Medium (high for PTS for non-piling activities)	Medium	Medium	Low	Medium	Medium	Medium	N/A	Medium
Humpback whale	High	Medium	Medium (high for PTS for non-piling activities)	Medium	Medium	Low	Medium	Medium	Medium	N/A	Medium
Grey seal	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Medium	Low
Harbour seal	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Medium	Low
Leatherback turtle	High	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	N/A	Low

10.12.1.2 Underwater noise and marine mammals and leatherback turtle

76. Underwater noise is one of the greatest potential impacts on marine mammals, depending on the source. To assess these effects, Southall et al. (2019) categorised marine mammals into hearing groups and applied species-specific auditory filters to unweighted noise levels to approximate their hearing sensitivities. This approach produces weighted SEL/$L_{E,p}$ criteria, representing the one-second continuous sound level containing the same acoustic energy as the actual event, accounting for both sound intensity (SPL/L_p) and duration. These weightings correct the received level according to the species' sensitivity, for example, harbour porpoise are less sensitive to low-frequency (LF) sound than minke, fin or humpback whales.

77. Leatherback turtles are also considered LF specialists (IOSEA Marine Turtles, 2025) and therefore sensitive to LF sound; however, as they do not rely on acoustic communication, they are likely less sensitive to underwater noise than marine mammals. The hearing group ranges for marine mammals and leatherback turtles are summarised in **Table 10.15**.

10.12.1.2.1 Impulsive and Non-Impulsive Noise

78. Noise sources are categorised as either impulsive or non-impulsive (Southall et al., 2019):

- Impulsive (single or multiple pulse): High peak sound pressure, short duration, fast rise-time and broad frequency content at source. Explosives, seismic airgun and impact piling are considered impulsive noise sources.
- Non-impulsive (or continuous non-pulsed sound): Vessel engines, vibro-piling, sonars, drilling and other low-level continuous noises are considered non-impulsive. Non-impulsive noise does not necessarily have to have a long duration.

79. Underwater sound levels are expressed in decibels (dB), a logarithmic scale where equal increments do not represent equal changes in perceived loudness; a doubling of sound energy typically results in a similar increase in perceived loudness (see **Appendix 10.1 Underwater Noise Modelling Report**, Section 2.1).

80. Sound Pressure Level SPL / L_p) describes continuous noise and represents the average unweighted sound level over a defined measurement interval. Peak Sound Pressure Level (SPL_{peak} / $L_{p\text{-}pk}$) characterises transient, impulsive sounds (e.g. impact piling) and represents the maximum instantaneous pressure excursion within a sound wave. SEL / $L_{E,p}$ represents the acoustic energy of a sound event, combining both sound level and duration, expressed as an equivalent continuous sound level over one second (see **Appendix 10.1 Underwater Noise Modelling Report**).

81. Sound exposure level from single strike (SELss / $L_{E,p,ss}$) refers to the sound exposure level from an individual hammer strike, at either initial or maximum hammer energy.

82. Cumulative Sound Exposure Level (SEL_{cum} / $L_{E,p,t}$) represents total acoustic energy over the full piling sequence, including soft-start, ramp-up and full installation. Marine mammal movement is incorporated using species-specific swim speeds

- Harbour porpoise (Very High Frequency (VHF)): 1.4 m/s (SNH 2016);
- Delphinids: (High Frequency (HF)): 1.52 m/s (Bailey and Thompson, 2006);
- Mysticetes (Low Frequency (LF)): 2.1 m/s (SNH, 2016); and
- Pinnipeds in water (Phocid Carivores in Water (PCW)): 1.8 m/s) (SNH, 2016);

83. Interpretation of SEL_{cum} exposures assumes injury risk applies to individuals present within the impact range at the onset of piling (see **Appendix 10.1 Underwater Noise Modelling Report**, Section 2.3.1).

84. The assessment metrics and criteria reflect current guidance and advice from the MachairWind Scoping Workshop (01 May 2024) and statutory consultation responses (**Table 10.2**).

85. The underwater noise modelling and assessment apply worst-case and precautionary assumptions for both the noise source and the behaviour of marine mammals and leatherback turtle. Modelling assumed maximum hammer energy and piling duration at all locations. The west location within the WDA was identified as having the greatest potential for noise propagation and was used as the worst-case for the Project.

86. Marine mammals and leatherback turtles were assumed to remain continuously submerged within the mid-water column, where sound levels are typically highest. This does not reflect natural behaviour, as cetaceans, pinnipeds and leatherback turtles regularly surface to breathe and rest, where sound pressure levels are generally lower. Telemetry data indicate that harbour porpoises spend a substantial proportion of time near the surface (up to 61.5% in April and 42.5% in February; Teilmann et al., 2012), suggesting that modelled exposures are likely conservative. Although assessments often assume uniform responses within exposure contours, increasing evidence supports probabilistic dose–response relationships, with individual responses varying across exposure levels. Thompson et al. (2013) showed that the probability of PTS in harbour seals increases gradually with cumulative sound exposure, rather than occurring at a single threshold.

87. Soft-start and ramp-up procedures are routinely applied as embedded mitigation to reduce the risk of auditory injury by allowing marine mammals time to move away from the sound source before full hammer energy is applied. However, recent evidence from pile-driving activities in the Moray Firth demonstrates that this assumption does not always translate directly into lower received noise levels. Specifically, measured data showed that received levels at a given distance may, in some circumstances, be highest during the initial low hammer-energy phases of piling, largely due to shallow pile penetration resulting in less energy dissipation into the seabed and greater sound radiation into the water column (Thompson et al., 2020). This finding highlights that the effectiveness of soft-start and ramp-up as mitigation is influenced by site-specific factors such as foundation type, ground conditions and installation sequence, and therefore should not be assumed to be uniformly effective without consideration of project-specific context.

88. Impulsive sound typically poses a greater risk to receptors than non-impulsive sound because it delivers intense acoustic energy over a very short period, increasing the likelihood of auditory injury or behavioural disruption. Its sudden onset and high peak pressure can damage sensitive auditory structures, such as hair cells in the cochlear duct of marine mammals, and it may retain sufficient intensity as it propagates to affect marine wildlife.

89. Southall et al. (2019) provide unweighted peak sound pressure criteria (SPL_{peak} /$L_{p,pk}$), weighted SEL criteria, and cumulative weighted sound exposure criteria (SEL_{cum} /$L_{p,pk}$) for impulsive sources—including pile driving, pingers, and UXO clearance covering both PTS, where hearing loss is irreversible, and TTS, where hearing sensitivity recovers over time. Southall et al. (2019) also set out criteria based on unweighted SPL_{peak} / $L_{p,pk}$, which do not incorporate species-specific hearing sensitivity. These criteria represent a different metric from weighted SEL based thresholds and therefore should not be directly compared. For the purposes of this assessment, the criteria predicting the greatest impact ranges have been applied consistently for all underwater noise impact pathways. The unweighted SPL_{peak} /$L_{p,pk}$ thresholds presented by Southall et al. (2019) are identical to those published by the NMFS, (2018), although NMFS has since reviewed these in a 2024 update. NatureScot supports continued use of the NMFS (2018) / Southall et al. (2019) thresholds, stating: *"We are content with the data sources, and we are advising to continue using the National Marine Fisheries Service (NMFS) (2018) / Southall et al. (2019) thresholds for assessments as we are not yet in a position to recommend using the NMFS 2024 thresholds."* (see **Table 10.2**).

90. The Southall et al. (2019) thresholds and criteria for PTS and TTS impacts on marine mammals and the NMFS (2025) criteria for turtles is used in the assessments and are summarised in **Table 10.15**.

Table 10.15 Receptor hearing ranges (Southall et al., 2019; IOSEA marine turtles , 2025) and receptor thresholds and criteria used in the underwater noise modelling and assessments (Southall et al., 2019; NMFS 2025)

Species hearing group	Generalised hearing range	Impact	Unweighted SPL_{peak} / $L_{p,pk}$ (dB re 1 µPa) impulsive	Weighted SEL_{ss} / $L_{E,p,ss}$ and SEL_{cum} / $L_{E,p,t}$ (dB re 1 µPa2s)	
				Impulsive	Non-impulsive
Harbour porpoise [Very high-frequency cetaceans (VHF)]	275 Hz to 160 kHz	PTS	202	155	179
		TTS	196	140	153
Delphinid species including killer whale and long-finned pilot whale [High-frequency cetaceans (HF)]	150 Hz to 160 kHz	PTS	230	185	198
		TTS	224	170	178
Minke whale, fin whale, humpback whale [Low-frequency cetaceans (LF)]	7 Hz to 35 kHz	PTS	219	183	199
		TTS	213	168	179
Grey seal, harbour seal [Phocid carnivores in water (PCW)]	50 Hz to 86 kHz	PTS	218	185	201
		TTS	212	170	181
Leatherback turtle [HF]*	50 Hz to 1.6 kHz	PTS	230	184	198
		TTS	224	169	178
** Leatherback turtle impact assessments are assessed using delphinid magnitudes and significance of effect.*					

91. **Table 10.15** shows that leatherback turtles have PTS and TTS thresholds broadly comparable to those of delphinid species. Given the rare occurrence of leatherback turtles in the Inner Hebrides, both the magnitude and significance of effect for this species are assumed to be consistent with those assessed for delphinids, such as killer whale (NA) and long-finned pilot whale. The magnitude and significance of effect for humpback whale are assumed to follow those assessed for fin whale.

92. These PTS and TTS thresholds are used to estimate the number of animals that may be exposed to permanent or temporary hearing loss. PTS represents a loss of hearing sensitivity that does not recover after exposure ends or between repeated exposures, while TTS represents a temporary reduction in sensitivity from which an animal can recover.

93. The likelihood of an individual experiencing PTS or TTS depends on both sound intensity and exposure duration:

- PTS can result from prolonged exposure to elevated noise levels, such as during extended pile installation, where cumulative sound exposure (SEL_{cum}/ $L_{E,p,t}$) is the dominant factor. It can also occur following repeated episodes of TTS and does not return to pre-exposure levels over time.
- TTS may occur from long-duration exposure of low-level noise or a short-duration exposure to higher-level noise. Unlike PTS, hearing sensitivity returns to pre-exposure levels over time.

94. Auditory injury has been assessed for all receptors from noisy activities that will occur due to the construction, O&M and/or decommissioning of the Project; such as geophysical surveys (**Section 10.12.1.3**); UXO clearance (**Section 10.12.1.4**); impact pile driving (**Section 10.12.1.5**), non-piling construction/O&M activities (**Section 10.12.1.7**), vessel activity (**Section 10.12.1.8**) and underwater noise from operating WTG (**Section 10.12.1.13**).

10.12.1.3 Impact 1: Underwater noise during geophysical surveys

95. Geophysical surveys may be undertaken post-consent to inform project design work.

96. Prior to any geophysical surveys, an EPS Risk Assessment will be undertaken to determine whether the proposed surveys are likely to cause disturbance or auditory injury to cetacean species.

97. The information in this section is based on a precautionary worst-case scenario. Geophysical surveys may use a range of equipment types; which are summarised in **Table 10.16**. Where specific equipment models are referenced, these are provided as examples only; final equipment selection will be confirmed during the EPS licence process that the Applicant will complete before any survey work begins. **Table 10.16** presents the potential frequency ranges and sound levels associated with the geophysical survey equipment.

Table 10.16 Examples of intensity and frequency of sound sources associated with geophysical surveys

Potential Equipment	Typical frequency range	Expected sound Level	Description	Potential Risk to Marine Mammals
Sub-Bottom Profilers (SBP)	Sparker: 100 Hz – 5 kHz Boomer: 100 Hz – 15 kHz Pinger: 1 – 40 kHz Chirp: 5 – 20 kHz Parametric: 85 – 115 kHz (Majewska et al., 2025)	Sparker: SPL_{pk} 215 - 255 dB re 1 µPa @ 1m Boomer: SPL_{pk} 205 - 215 dB re 1 µPa @ 1m Pinger: 214 dB re 1 µPa @ 1m Chirp: 185 - 215 dB re 1 µPa @ 1m Parametric: SPL_{rms} 200 - 247 dB re 1 µPa @ 1m (Majewska et al., 2025)	SBP systems are used to identify and characterise layers of sediment or rock under the seafloor. A transducer emits a broadband pulse vertically downwards towards the seafloor, and a receiver records the return of the pulse once it has been reflected off the seafloor.	The frequency range produced by SBP equipment can overlap with the hearing sensitivity of cetaceans, meaning that marine mammals in the vicinity may be able to detect the sound. As a result, there is a possibility that the noise could cause behavioural disturbance. However, the sound is brief, directed downward, and the survey vessel is constantly moving. This makes hearing damage unlikely, as animals would need to stay in the small high-intensity zone for an extended time (JNCC, 2017).
Multibeam Echo Sounder (MBES)	100 – 400 kHz (Majewska et al., 2025)	SPL_{rms} 210 - 240 dB re 1 µPa @ 1 m (Majewska et al., 2025)	MBES are used to obtain detailed maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a HF pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). MBES can, typically, carry out 200 or more simultaneous measurements.	JNCC (2017) found that MBES systems can emit sound levels up to 236 dB re 1 µPa @ 1 m, with frequencies between 10–200 kHz. While this could theoretically cause hearing damage to marine mammals, such injury is unlikely unless an animal is extremely close to the source. Short-term use of MBES is also unlikely to cause disturbance, as the operating frequencies often fall outside the hearing range of marine mammals. Surveys in waters shallower than 200m typically use higher frequencies (200–400 kHz), which attenuate quickly and are not considered a risk. JNCC (2017)

Potential Equipment	Typical frequency range	Expected sound Level	Description	Potential Risk to Marine Mammals
				therefore advises that mitigation is generally not needed for shallow-water MBES surveys.
Side Scan Sonar (SSS)	100 – 900 kHz (Hartley Anderson Ltd; 2020).	SPL range: 205 to 230 dB re: 1 µPa @ 1 m / SEL: 200 dB re: 1 µPa2-s (Hartley Anderson Ltd; 2020).	SSS is used to generate an accurate image of the seabed. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. The instrument can either be towed behind a ship at a specified depth or mounted to a Remotely Operated Vehicle (ROV). The higher frequency systems provide higher resolution, but shorter-range measurements.	SSS typically operates at very high frequencies, which are generally beyond the hearing range of marine species (JNCC et al., 2010). Similar to MBES systems used in shallow waters (<200 m) SSS emit high-frequency sounds that attenuate rapidly and are unlikely to be detected by marine mammals. As such, mitigation measures are not considered necessary for these surveys (JNCC, 2017).
Ultra-Short Baseline (USBL)	17 – 34 kHz (Majewska et al., 2025)	SPL_{rms} <200 – 206dB re 1 µPa @ 1m (Majewska et al., 2025)	USBL systems are used to determine the position of subsea survey items, including ROVs, towed sensors, etc. This involves the emission of sound from a hull-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. A complete USBL system consists of a small transducer array, which is mounted under a ship, and a transponder attached to the subsea unit. An acoustic pulse is transmitted by the transducer, travels through the water and is detected by the shipboard transducer on an onboard computer calculates the time from the transmission of the initial acoustic pulse until the reply is detected and is measured by the USBL system. This is converted into a range and bearing, and thus the position of the subsea unit / sampling equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting.	Low-frequency sounds, like those from USBL systems, travel farther than high-frequency emissions, increasing the area over which cetaceans may be exposed. However, USBL use is typically intermittent, and the moving survey vessel reduces the chance of prolonged exposure. As a result, the risk of auditory injury is considered low. However, USBL frequencies fall within the hearing range of cetaceans expected in the WDA, so there is potential for temporary disturbance during survey activities (JNCC, 2017).

Potential Equipment	Typical frequency range	Expected sound Level	Description	Potential Risk to Marine Mammals
Ultra-high resolution (UHR) sparker (HD) (DuraSpark 400 UHD)	E.g. 0.5 – 4 kHz	E.g. SPL: 220 dB re: 1 µPa @ 1 m / SEL: 193 dB re: 1 µPa2-s	Applied Acoustics' Dura-Spark UHD is an UHR dual sparker system classified as a medium penetration impulsive source used to map deeper subsurface stratigraphy. Sparkers are powerful devices and can be used to penetrate seabed layers (JNCC, 2017).	The Dura Spark 400 UHD emits low-frequency, high-intensity impulsive sounds that fall within the hearing range of many cetaceans. These sounds can travel long distances underwater, increasing the potential for exposure. While the risk of auditory injury is low due to the short pulse duration and downward direction of the sound, there is a moderate risk of behavioural disturbance, especially if sensitive species are nearby during survey operations. Mitigation measures such as soft starts and MMOs are recommended in line with JNCC (2017) guidance.
Geotechnical Works: Boreholes: piston, push and hammer soil sampling, wireline rock coring, P-S wave logging, cone penetration tests (CPTs) and seismic wave cone penetration tests (SCPTs) Seabed CPTs and SCPTs	30 Hz	188 dB re 1µPa @1 m (root mean square (rms))	The boreholes will be created through drilling techniques. They are then tested using P-S wave logging system, which generates a very localised sound source to measure seismic pressure and shear wave velocity. CPTs uses wave generators that generate seismic shear waves below the seabed that are measured to determine the small strain shear modulus of the soil.	Borehole seismic surveys (e.g. Vertical Seismic Profiling or VSP) typically use high-energy impulsive sources, which can generate underwater noise capable of causing auditory injury or disturbance to marine mammals if they are nearby. However, the risk is generally low due to the short duration and focused nature of the activity. JNCC recommends mitigation measures such as soft-start procedures and MMOs to reduce risk, especially in areas where sensitive species may be present (JNCC, 2017).
Seismic CPT (SCPT)	16 Hz – 8 kHz	122 dB at 1 m distance (per hammer strike/seismic test)	A seismic CPT (SCPT) is an enhanced form of cone penetration testing that measures both the geotechnical properties of the seabed and the seismic wave velocities within subsurface soils. The test combines standard CPT measurements (tip resistance, sleeve friction, and pore pressure) with downhole geophones or accelerometers to record the travel time of shear (Vs) and compression (Vp) waves generated at the surface. This allows	Seismic CPT involves generating low-energy seismic waves to assess subsurface conditions. These waves are typically of low amplitude and short duration, making auditory injury unlikely. However, there is a low potential for disturbance, particularly for species sensitive to low-frequency sounds. JNCC guidelines suggest that standard mitigation practices (e.g. soft starts and monitoring) should be applied where appropriate.

Potential Equipment	Typical frequency range	Expected sound Level	Description	Potential Risk to Marine Mammals
			engineers to characterise soil stiffness, stratigraphy, and dynamic behaviour, providing essential information for foundation design in offshore developments.	
P-S wave logger	28 Hz	peak 28 dB	A P–S wave logger is a downhole geophysical instrument used to measure the velocities of primary (P-waves) and secondary (S-waves) in subsurface soils. By recording the travel times of both compression and shear waves generated at the surface or from a controlled source, the logger provides essential data on soil stiffness, dynamic behaviour, and stratigraphy. These measurements support geotechnical characterisation for offshore foundation design, particularly where understanding soil response to dynamic loading is critical.	P-S wave logging uses controlled seismic sources to measure compressional and shear wave velocities. These systems produce moderate impulsive sounds that may fall within the hearing range of some marine mammals. While the risk of hearing damage is minimal, there is a potential for short-term behavioural disturbance if animals are close to the source. JNCC (2017) advises using soft-start procedures, visual monitoring, and PAM to minimise impacts.

10.12.1.3.1 Sensitivity

98. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.3.2 Magnitude of Impact

99. The magnitude of underwater noise impacts during geophysical surveys is assumed to be the same across all phases of the WDA. This is based on an indicative assessment, as the number of surveys required during construction, O&M, and decommissioning has not yet been confirmed. Accordingly, the assessment adopts a precautionary worst-case approach, and the conclusions presented are considered applicable to all project phases.

10.12.1.3.2.1 Construction

10.12.1.3.2.1.1 Auditory Injury

100. The assessment is based on the use of a SBP, as this represents the worst-case equipment in terms of potential impacts on marine mammals and leatherback turtles.

101. An initial desk-based review of SBP impact ranges was undertaken to determine the potential worst case for geophysical surveys (**Table 10.17**). The Review of Consents HRA for the Southern North Sea (SNS) SAC (Department for Business, Energy and Industrial Strategy (BEIS), 2020) included underwater noise modelling to estimate SBP impact ranges for harbour porpoise.

102. The BEIS (2020) modelling used the maximum source level expected from an SBP—267 dB re 1 µPa m. It predicted that PTS in harbour porpoise could occur within a maximum radius of 23 m (0.0017 km²) from the source, based on a PTS cumulative weighted SEL threshold of 155 dB (Southall et al., 2019). The PTS ranges highlighted in bold in **Table 10.17** represent the worst-case distances and have been taken forward for the impact assessment.

*Table 10.17 Summary of the desk-based review of potential impact ranges for SBP (range of effect in **bold** has been taken forward for the PTS assessments)*

Equipment	Species	Potential effect	Threshold (and source)	Reported range of effect	Reference
Sub bottom profiler	Harbour porpoise	PTS onset	155 SEL_{cum} dB re 1 µPa (NMFS, 2018)	23 m	BEIS (2020)
Sub bottom profiler (SBP) (220 dB re 1 µPa @ 1m peak)	Harbour porpoise	PTS	Not reported	32 m	Neart na Gaiothe Offshore Wind (2019)
	Dolphin species	PTS	Not reported	0 m	
	Whale species	PTS	Not reported	5 m	
SBP	Harbour porpoise	PTS	202 dB peak / 155 dB SEL_{cum} (NMFS, 2018)	<3 m	Wieting (2019)

Equipment	Species	Potential effect	Threshold (and source)	Reported range of effect	Reference
(215 SPL_{peak} / $L_{p,pk}$ dB)	Dolphin species	PTS	230 dB peak / 185 dB SEL_{cum} (NMFS, 2018)	0 m	
	Whale species	PTS	219 dB peak, 183dB SEL_{cum} (NMFS, 2018)	<1 m	
SBP (4 kHz) (235 SPL_{peak} / $L_{p,pk}$ dB 1µPa)	**Harbour porpoise**	**PTS**	**202 dB peak / 155 dB SEL_{cum} (Southall et al., 2019)**	**445 m (0.062 km^2)**	**Scottish and Southern Energy (2020)**
	Dolphin species	**PTS**	**230 dB peak / 185dB SEL_{cum} (Southall et al., 2019)**	**98 m (0.03 km^2)**	
	Whale species	**PTS**	**219 dB peak, 183 dB SEL_{cum} (Southall et al., 2019)**	**178 m (0.10 km^2)**	
SBP (247 dB re 1 µPa @ 1m (rms))	**Pinnipeds**	**PTS**	**247 dB re 1 µPa @ 1m (rms)**	**120 m (0.045 km^2)**	**Flotation Energy & Royal HaskoningDHV (2023)**

103. Previous geophysical surveys within the WDA have assessed up to three vessels using geophysical equipment at the same time. Therefore, this assessment considers operations from either a single vessel, up to two vessels and up to three vessels operating at the same time.

104. **Table 10.18** presents the number of individuals (reference population) that could potentially be exposed to auditory injury (PTS) from geophysical surveys.

105. For auditory injury, all marine mammals and leatherback turtle have been assigned a sensitivity of high, and the magnitude of impact for all receptors has been assessed as **negligible**, with exception of harbour porpoise and bottlenose dolphin (CWSH population) where the magnitude for one, two and three vessels operating at the same time is assessed as **low** and for minke whale for three vessels where the magnitude is **low** (**Table 10.18**).

Table 10.18 PTS assessment for marine mammals for a sub-bottom profiler

Species	Maximum number of individuals (% of ref pop) – one vessel	Magnitude of impact (permanent)*	Maximum number of individuals (% of ref pop) – two vessels	Magnitude of impact (permanent)*	Maximum number of individuals (% of ref pop) – three vessels	Magnitude of impact (permanent)*
Harbour porpoise	<1 (0.001% WS MU)	Low	1 (0.002% WS MU)	Low	<2 (0.003% WS MU)	Low
Bottlenose dolphin	<1 (0.003% CWSH MU & 0.0001% OW MU)	Low (CWSH MU) Negligible (OW MU)	<1 (0.006% CWSH MU & 0.0002% OW MU)	Low (CWSH MU) Negligible (OW MU)	<1 (0.009% CWSH MU & 0.0003% OW MU)	Low (CWSH MU) Negligible (OW MU)
Short beaked common dolphin	<1 (0.00004% CGNS MU)	Negligible	<1 (0.00008% CGNS MU)	Negligible	<1 (0.0001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000005% CGNS MU)	Negligible	<1 (0.00001% CGNS MU)	Negligible	<1 (0.00002% CGNS MU)	Negligible
White-beaked dolphin	<1 (0.00002% CGNS MU)	Negligible	<1 (0.00004% CGNS MU)	Negligible	<1 (0.00006% CGNS MU)	Negligible
Risso's dolphin	<1 (0.000003% CGNS MU)	Negligible	<1 (0.000006% CGNS MU)	Negligible	<1 (0.000009% CGNS MU)	Negligible
Killer whale	<1 (0.00004% WCC & 0.0000002% NA)	Negligible (WCC & NA)	<1 (0.00008% WCC & 0.0000004% NA)	Negligible (WCC & NA)	<1 (0.0001% WCC & 0.0000006% NA)	Negligible (WCC & NA)
Long-finned pilot whale	<1 (0.000003% NA)	Negligible	<1 (0.000006% NA)	Negligible	<1 (0.00001% NA)	Negligible
Minke whale	<1 (0.0002% CGNS MU)	Negligible	<1 (0.0004% CGNS MU)	Negligible	<1 (0.001% CGNS MU)	Low
Fin whale	<1 (0.000006% NA)	Negligible	<1 (0.00001% NA)	Negligible	<1 (0.00002% NA)	Negligible
Humpback whale	Not assessed (N/A)	Negligible	N/A	Negligible	N/A	Negligible
Grey seal*	<1 (0.0002% WS MU & 0.00008% Wider MU)	Negligible (negligible)	<1 (0.0004% WS MU & 0.0002% Wider MU	Negligible (negligible)	<1 (0.0006% WS MU & 0.0002% Wider MU	Negligible (negligible)
Harbour seal *	<1 (0.00002% WS MU & 0.00001% Wider MU)	Negligible (negligible)	<1 (0.00004% WS MU & 0.00002% Wider MU	Negligible (negligible)	<1 (0.00006% WS MU & 0.00003% Wider MU	Negligible (negligible)
Leatherback turtle	N/A	Negligible	N/A	Negligible	N/A	Negligible
** Magnitudes in brackets are for the wider reference populations used in the assessment*						

10.12.1.3.2.1.2 Disturbance and Behavioural Impacts

106. As outlined in **Table 10.2**, NatureScot requested following ETG 2 that a precautionary approach be applied when assessing potential disturbance from geophysical surveys. In line with JNCC (2020) guidance, this involves using a 5 km EDR per vessel.

107. As a worst-case scenario, **Table 10.19**. presents the maximum number of marine mammals (expressed as a percentage of the reference population) that could be disturbed by one, two, or three vessels operating simultaneously. Because no density estimate is available for humpback whale, its magnitude of impact is assumed to be the same as for minke and fin whale. For leatherback turtle, the magnitude is assumed to match that of the delphinid group. The sensitivity is medium for all receptors, due to having the ability to adapt and move away. For bottlenose dolphin the magnitude is assessed as **medium** for a single geophysical vessel and **high** for two or three vessels operating in the WDA at the same time. For killer whale (WCC) the magnitude is assessed as **low** for two or three vessels operating in the WDA at the same time and for grey seal (WS MU) the magnitude is assessed as **low** for three vessels operating at the same time in the WDA. For one, two or three vessels operating at the same time, the magnitude is assessed as **negligible** for all other receptors (**Table 10.19**).

Table 10.19 Disturbance assessment for marine mammals for a sub-bottom profiler

Species	Maximum number of individuals (% of ref pop) – one vessel	Magnitude of impact (temporary)*	Maximum number of individuals (% of ref pop) – two vessels	Magnitude of impact (temporary)*	Maximum number of individuals (% of ref pop) – three vessels	Magnitude of impact (temporary)*
Harbour porpoise	33 (0.1% WS MU)	Negligible	66 (0.3% WS MU)	Negligible	99 (0.4% WS MU)	Negligible
Bottlenose dolphin	3 (7.4% CWSH MU & 0.3% OW MU)	Medium (CWSH MU) Negligible (OW MU)	7 (15.5% CWSH MU & 0.5% OW MU)	High (CWSH MU) Negligible (OW MU)	10 (22.2% CWSH MU & 0.7% OW MU)	High (CWSH MU) Negligible (OW MU)
Short beaked common dolphin	63 (0.1% CGNS MU)	Negligible	126 (0.2% CGNS MU)	Negligible	189 (0.3% CGNS MU)	Negligible
Atlantic white-sided dolphin	2 (0.01% CGNS MU)	Negligible	4 (0.03% CGNS MU)	Negligible	6 (0.04% CGNS MU)	Negligible
White-beaked dolphin	20 (0.06% CGNS MU)	Negligible	40 (0.1% CGNS MU)	Negligible	60 (0.17% CGNS MU)	Negligible
Risso's dolphin	<1 (0.009% CGNS MU)	Negligible	2 (0.02% CGNS MU)	Negligible	3 (0.03% CGNS MU)	Negligible
Killer whale	<1 (0.9% WCC & 0.0005% NA)	Negligible (WCC & NA)	<1 (1.9% WCC & 0.02% NA)	Low (WCC) Negligible (NA)	<1 (2.9% WCC & 0.02% NA)	Low (WCC) Negligible (NA)
Long-finned pilot whale	3 (0.009% NA)	Negligible	6 (0.02% NA)	Negligible	9 (0.02% NA)	Negligible
Minke whale	17 (0.16% CGNS MU)	Negligible	34 (0.3% CGNS MU)	Negligible	51 (0.5% CGNS MU)	Negligible
Fin whale	<1 (0.004% NA)	Negligible	<1 (0.008% NA)	Negligible	1 (0.001% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible	N/A	Negligible
Grey seal*	68 (0.4% WS MU & 0.1% Wider MU)	Negligible (negligible)	136 (0.7% WS MU & 0.2% Wider MU)	Negligible (negligible)	204 (1.2% WS MU & 0.4% Wider MU)	Low (negligible)
Harbour seal*	6 (0.03% WS MU & 0.01% Wider MU)	Negligible (negligible)	13 (0.06% WS MU & 0.03% Wider MU)	Negligible (negligible)	19 (0.1% WS MU & 0.06% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	Negligible	N/A	Negligible	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*						

10.12.1.3.2.2 O&M

108. The magnitude of impact is the same as construction see **Section 10.12.1.3.2.1**.

10.12.1.3.2.3 Decommissioning

109. The magnitude of impact is the same as construction see **Section 10.12.1.3.2.1**.

10.12.1.3.3 Significance of Effect

110. For geophysical surveys, embedded mitigation includes:

- Standard mitigations as set out in JNCC (2017) guidelines for minimising the risk of injury to marine mammals from geophysical surveys, such as pre-survey watches and soft-start (where practicable) (see **Table 10.8**; M-12).

111. For auditory injury (PTS), all marine mammals and leatherback turtles have been assigned a sensitivity of **high** (**Table 10.14**). The quantitative assessment for geophysical surveys does not account for embedded mitigation such as the use of MMO and PAM (as listed above). For harbour porpoise and bottlenose dolphin (CWSH population), the magnitude is assessed as **low** resulting in a moderate adverse effect. However, with embedded mitigation as secured through **Appendix 9 Draft MMMP** the effect would be **minor adverse,** which is **not significant** in EIA terms. For minke whale, the magnitude is assessed as low for three vessels operating at the same time, however with embedded mitigation, the significance of effect would result in a **minor adverse** effect**,** which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible** resulting in a **minor adverse** effect, **not significant** in EIA terms whether a single or multiple vessels are operating.

112. For disturbance from geophysical surveys, for grey seal, the magnitude for three vessels operating at the same time is **low**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For killer whale the magnitude for two or three geophysical vessels is assessed as **low**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For bottlenose dolphin (CWSH MU) the magnitude for one geophysical vessel is assessed as **medium**, and for two or three vessels operating at the same is assessed as **high.** However, the magnitude is deemed unrealistic because the CWSH MU consists of only 45 individuals and any disturbance would be temporary. In addition, the 5 km EDR which is recommended to be applied to bottlenose dolphin is based on harbour porpoise sensitivity to geophysical surveys which are generally more sensitive to underwater noise compared to delphinids. Thus, application of a 5 km EDR to bottlenose dolphin is considered over precautionary and not realistic. Therefore, based on professional judgement and embedded mitigation as secured through **Appendix 9 Draft MMMP**, the significance of effect on bottlenose dolphin (CWSH MU) is considered to be **minor adverse**, **not significant** in EIA terms. For all other all receptors the sensitivity is assigned as **medium**, and all have been assessed as **negligible** resulting in a **negligible adverse** effect, which is **not significant** in EIA terms; whether it is a single or multiple vessels operating.

10.12.1.3.3.1 Designated sites

113. As shown in **Table 10.7**, there are a number of marine mammal designated sites that may be affected by Project related geophysical surveys. For harbour porpoise, the SAC populations (of the Inner Hebrides and the Minches and Skerries and Causeway SACs) are part of the WS MU, which is the focus of the harbour porpoise assessment provided in this EIAR. There would be no significant effect

on the harbour porpoise populations of either SAC, as there is no significant effect on the WS MU due to underwater noise emitted from geophysical surveys, as shown by **Table 10.20** below.

114. For minke whale, there is one designated site that may be affected by Project related geophysical surveys; the Sea of the Hebrides NCMPA. Based on the NCMPA specific minke whale density, as presented in **Report to Inform Marine Protected Area Assessment,** less than 1 minke whale may be at risk of PTS onset, and up to 9 minke whale may be at risk of disturbance from Project related geophysical surveys. This equates to 0.002% and 0.9% of the NCMPA population respectively. With the sensitivity of high and medium, and magnitude of impact negligible, this would not equate to a significant effect in EIA terms (**Table 10.20**).

115. For pinnipeds, there are a number of designated sites that may be affected by geophysical surveys; Treshnish Isles SAC (for grey seal), and South-East Islay Skerries, Eileanan agus Sgeiran Lios mor, Sound of Barra and Ascrib, Isay and Dunvegan SACs, all designated for harbour seal. These SAC populations are part of the wider population, which is assessed as part of the EIA assessments. As there are no significant effects on the wider populations, there would also not be any significant effect to grey or harbour seal of any of the above listed designated sites (**Table 10.20**).

Table 10.20 Significance of effect for impact 1: Underwater noise during geophysical surveys (blue shaded cells = with embedded mitigation)

Phase	Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
All phases	Auditory Injury (PTS)	Harbour porpoise	High	Low	Minor adverse	N/A	Not significant
		Bottlenose dolphin		Low (CWSH MU) Negligible (OW MU)	Minor adverse (CWSH MU & OW MU)		Not significant (CWSH MU & OW MU)
		Short beaked common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Minor adverse		Not significant
		Killer whale		Negligible (WCC & NA)	Minor adverse (WCC & NA)		Not significant (WCC & NA)
		Grey seal & harbour seal*		Negligible (negligible)	Minor adverse (minor adverse)		Not significant
		Minke whale		Negligible-Low	Minor adverse		Not significant
		Leatherback turtle		Negligible	Minor adverse		Not significant
All phases	Disturbance	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
		Bottlenose dolphin*		Medium-High (CWSH MU) Negligible (OW MU)	Minor adverse (CWSH MU & OW MU)		Not significant (CWSH MU & OW MU)
		Short beaked common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale		Negligible	Negligible adverse		Not significant

Phase	Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
		Killer whale		Negligible-Low (WCC) Negligible (NA)	Negligible adverse (WCC & NA)		Not significant (WCC & NA)
		Grey seal*		Negligible-Low (negligible)	Negligible adverse (negligible adverse)		Not significant
		Harbour seal *		Negligible (negligible)	Negligible adverse (negligible adverse)		Not significant
		Leatherback turtle		Negligible	Negligible adverse		Not significant
Magnitudes and significant effects in brackets are for the wider reference populations used in the assessment							

10.12.1.4 Impact 2: Underwater noise during UXO clearance

116. Prior to and during construction, unexploded ordnance (UXO) may require clearance. Although UXO will be avoided or removed and disposed of at designated locations wherever possible, underwater detonation may be necessary if a device cannot be safely recovered.

117. Under the Marine (Scotland) Act 2010, UXO clearance in Scottish inshore waters constitutes a licensable marine activity, requiring a marine licence from Marine Scotland where explosives are used or seabed disturbance occurs. This licence is separate from the Marine Licence for the construction and operation of the WDA infrastructure. Clearance involving detonation will also require a risk assessment and may require an EPS Licence under the Conservation (Natural Habitats, &c) Regulations 1994. An ML application will be submitted following completion of a detailed UXO survey and once an updated assessment based on the latest available information has been undertaken.

118. The number of UXO items that may require clearance and the duration of clearance operations are not yet known. As such, the assessment is based on a realistic worst-case scenario. Further detail on UXO, impact magnitudes and significance of effect for all receptors is provided in **Appendix 10.6 UXO Clearance Assessment on Marine Mammals and Leatherback Turtle**.

10.12.1.5 Impact 3: Auditory Injury from Underwater Noise During Piling

119. Underwater noise modelling was carried out by Subacoustech Environmental Ltd to predict the potential noise levels expected to occur during piling and non-piling activities (**Appendix 10.1 Underwater Noise Modelling Report**). The modelled impact ranges were used to determine the potential effects on marine mammals.

120. The underwater noise modelling includes predictions for auditory injury (PTS and TTS) based on the Southall et al. (2019) metrics and criteria (see Section 2.3.1 in **Appendix 10.1 Underwater Noise Modelling Report**).

121. The modelling employed the Impulsive Noise Propagation and Impact Estimator (INSPIRE) v6, a semi-empirical tool that integrates numerical simulations with real-world underwater noise measurements. This model is specifically designed to simulate noise propagation in shallow, mixed waters, which are characteristic of many UK coastal environments. Further technical details are available in **Appendix 10.1 Underwater Noise Modelling Report**.

122. Confidence in the modelling approach and its outputs is discussed in detail in Section 3.1 of **Appendix 10.1 Underwater Noise Modelling Report**.

10.12.1.5.1 Methodology

123. Modelling was undertaken at four representative locations covering the extents of the WDA for WTGs and OSPs, giving a spread of water depths, distances to shore and bathymetry stretching into deeper water around the site (see **Appendix 10.1 Underwater Noise Modelling Report**).

124. The worst-case scenario for both monopiles and pin-piles was defined using the maximum impact ranges modelled for the west location. Impact ranges for each marine mammal hearing group (**Table 10.15**) were predicted for both foundation types (monopiles and pin-pile jackets), and the sequential installation of pin-piles was also assessed. These modelling outputs have been used to determine the maximum potential effects on receptor groups, providing a conservative basis for the impact assessment.

125. Additional underwater noise modelling included an arbitrary scenario assuming a 10 dB noise reduction to represent the reduction in noise levels that could potentially be achieved were primary noise reduction methods, or secondary noise reduction systems, implemented during piling in the WDA (see **Appendix 9 Draft MMMP** for information). The results of this modelling are provided within **Appendix 10.1 Underwater Noise Modelling Report**.

126. The underwater noise modelling was based on the following worst-case piling scenarios:

- 15 m diameter monopiles for WTG foundations installed using a maximum blow energy of 6,600 kJ.
- 4.5 m diameter pin-piles for WTG and OSP foundations installed with a maximum blow energy of 4,400 kJ.

127. To evaluate the potential for PTS based on SEL_{cum} / $L_{Ep,t,}$ the modelling incorporated relevant embedded mitigation measures, including soft-start and ramp-up procedures, leading to maximum hammer energy, total installation duration, and strike rate. The soft-start, ramp-up, and overall piling durations used to calculate SEL_{cum} / $L_{Ep,t}$_for both pile types are summarised in **Appendix 10.1 Underwater Noise Modelling Report**. Other embedded mitigation measures, such as the deployment of MMOs, PAM and ADDs, are not accounted for within the quantitative modelling but are considered as part of the determination of significance of effect.

128. As a precautionary worst-case, it was assumed that the maximum hammer energy would be applied for the entire remaining duration of each installation. In practice, maximum hammer energy is only expected to be required for a small proportion of piling operations and for shorter periods, meaning the modelling and resulting assessments are considered highly conservative.

129. There would be no simultaneous piling within the WDA. The maximum number of monopiles installed in a 24-hour period would be one. The maximum number of pin-piles installed sequentially in a 24-hour period would be six.

10.12.1.5.2 Impact 3a: Permanent auditory injury (PTS) due to impact piling

130. PTS can occur instantaneously when an animal is exposed to a high-level, acute noise event; such as a single hammer strike at maximum energy, represented by SPL_{peak} / $L_{p\text{-}pk}$. It can also develop through prolonged exposure to elevated noise during the full piling duration, reflected in SEL_{cum} / $L_{Ep,t}$. Any PTS is permanent, and receptors within the potential impact zone have limited ability to avoid these effects and therefore cannot recover once the auditory injury has occurred.

10.12.1.5.2.1 Sensitivity

131. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.5.2.2 Magnitude of Impact

10.12.1.5.2.2.1 Construction

10.12.1.5.2.2.1.1 Permanent Threshold Shift from Single Strike at Maximum Hammer Energy

132. **Table 10.21** presents the predicted effect ranges and areas for instantaneous PTS from a single hammer strike at maximum energy. Harbour porpoise show the greatest susceptibility, with maximum PTS ranges of 980 m for monopiles and 750 m for pin-piles without mitigation. These predicted PTS

ranges from a single maximum-energy strike will be used to inform the MMMP for piling / Piling Noise Mitigation Plan (see **Appendix 9 Draft MMMP**).

133. **Table 10.21** presents the predicted instantaneous PTS impact ranges for delphinids (HF cetaceans), all of which are less than 50 m. At these distances, PTS is not expected, as modelled sound levels do not exceed the relevant auditory injury thresholds. Nevertheless, to maintain a precautionary approach, the assessment includes an assumed impact area of 0.01 km² for delphinids, which has been applied to leatherback turtle due to having similar PTS thresholds. All receptors have been assigned a sensitivity of high for PTS, due to the high international value and low recoverability (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**). The magnitude for PTS from first strike and single strike at maximum hammer energy is assessed as low for harbour porpoise and negligible for all other receptors (**Table 10.22**) accounting for only soft-start and ramp-up as embedded mitigation.

Table 10.21 Predicted PTS impact ranges (and areas) from first strike and single strike SPL_{peak} / $L_{p\text{-}pk}$ at maximum hammer energy for monopile and pin-pile

Species	Impact	Maximum impact range and area monopiles	Maximum impact range and area pin-piles
Harbour porpoise (VHF)	PTS from first strike (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.5 km (0.79 km²)	0.37 km (0.42 km²)
	PTS from single strike at full energy (*6,600 kJ for monopolies and 4,440 kJ for pin-piles*)	0.98 km (3.0 km²)	0.78 km (1.9 km²)
Delphinids (HF)	PTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	<0.05 km (<0.01 km²)	<0.05 km (<0.01 km²)
	PTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	<0.05 km (<0.01 km²)	<0.05 km (<0.01 km²)
Mysticetes (LF)	PTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	<0.05 km (<0.01 km²)	<0.05 km (<0.01 km²)
	PTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.08 km (0.02 km²)	0.05 km (0.01 km²)
Pinnipeds (PCW)	PTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.04 km (0.01 km²)	<0.05 km (<0.01 km²)
	PTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.09 km (0.03 km²)	0.07 km (0.01 km²)
Leatherback Turtle*	PTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	<0.01 km (<0.01 km²)	<0.01 km (<0.01 km²)
	PTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	<0.01 km (<0.01 km²)	<0.01 km (<0.01 km²)
** Leatherback turtle impact assessments are assessed using delphinid magnitudes and significance of effect.*			

Table 10.22 Assessment of the potential for instantaneous PTS (SPL_{peak} / L_{p-pk}) due to a first strike and single strike of the maximum hammer energy for a monopile and pin-pile

Species	Impact	Monopiles (*first strike at 550 kJ, full energy 6,600 kJ*)		Pin-piles (*first strike at 450 kJ, full energy 4,400 kJ*)	
		Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)
Harbour porpoise	PTS from first strike	<1 (0.001% WS MU)	Low	<1 (0.0007% WS MU)	Low
	PTS from single strike at full energy	2 (0.008% WS MU)	Low	1 (0.003% WS MU)	Low
Bottlenose dolphin	PTS from first strike	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
	PTS from single strike at full energy				
Common dolphin	PTS from first strike	<1 (0.00001% CGNS MU)	Negligible	<1 (0.00001% CGNS MU)	Negligible
	PTS from single strike at full energy				
Atlantic white-sided dolphin	PTS from first strike	<1 (0.000002% CGNS MU)	Negligible	<1 (0.000002% CGNS MU)	Negligible
	PTS from single strike at full energy				
White-beaked dolphin	PTS from first strike	<1 (0.000009% CGNS MU)	Negligible	<1 (0.000009% CGNS MU)	Negligible
	PTS from single strike at full energy				
Risso's dolphin	PTS from first strike	<1 (0.000001% CGNS MU)	Negligible	<1 (0.000001% CGNS MU)	Negligible
	PTS from single strike at full energy				
Killer whale	PTS from first strike	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
	PTS from single strike at full energy				
Long-finned pilot whale	PTS from first strike	<1 (0.0000002% NA)	Negligible	<1 (0.0000002% NA)	Negligible
	PTS from single strike at full energy				
Minke whale	PTS from first strike	<1 (0.00002% CGNS MU)	Negligible	<1 (0.00002% CGNS MU)	Negligible
	PTS from single strike at full energy	<1 (0.00004% CGNS MU)	Negligible		
Fin whale	PTS from first strike	<1 0.0000006% NA)	Negligible	<1 0.0000006% NA)	Negligible
	PTS from single strike at full energy	<1 0.000001% NA)	Negligible		
	PTS from first strike	N/A	Negligible	N/A	Negligible

Species	Impact	Monopiles (*first strike at 550 kJ, full energy 6,600 kJ*)		Pin-piles (*first strike at 450 kJ, full energy 4,400 kJ*)	
		Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (permanent)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (permanent)**
Humpback whale	PTS from single strike at full energy				Negligible
Grey seal*	PTS from first strike	<1 (0.00005% WS MU & 0.00002% Wider MU)	Negligible (negligible)	<1 (0.00005% WS MU & 0.00002% Wider MU)	Negligible (negligible)
	PTS from single strike at full energy	<1 (0.0001% WS MU & 0.00005% Wider MU)	Negligible (negligible)		
Harbour seal*	PTS from first strike	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)
	PTS from single strike at full energy	<1 (0.00001% WS MU & 0.000007% Wider MU)	Negligible (negligible)		
Leatherback Turtle	PTS from first strike	N/A	Negligible	N/A	Negligible
	PTS from single strike at full energy				
**Magnitudes in brackets are for the wider reference populations used in the assessment*					

10.12.1.5.2.2.1.2 Permanent Threshold Shift from Cumulative Exposure for Single Pile Installation

134. **Table 10.23** presents the predicted cumulative PTS impact ranges (SEL_{cum} / $L_{E,p,t}$) for monopile and pin-pile installation. The (SEL_{cum} / $L_{E,p,t}$) represents the total acoustic energy received over the full piling sequence and indicates the minimum distance a receptor must begin fleeing from the source to avoid exceeding PTS thresholds (see **Appendix 10.1 Underwater Noise Modelling Report** for more information).

135. Mysticetes exhibit the largest predicted cumulative PTS ranges, with worst-case values of 27 km for monopiles and 16 km for pin-piles during a 24-hour installation (**Table 10.23**). However, as highlighted in Southall et al (2021), predicted PTS or TTS onset at distances greater than 10 km from impulsive sources such as pile driving is highly unlikely, meaning ranges in the tens of kilometres are considered overly precautionary.

136. For delphinids cumulative PTS ranges are less than 50 m, below relevant auditory injury thresholds. Nonetheless, a precautionary impact area of 0.01 km² has been applied in the assessment.

137. The magnitude for PTS from cumulative exposure of a single installation of a monopile and/or pin-pile at the maximum hammer energy is assessed as **high** for minke whale and **medium** for harbour porpoise, fin whale and humpback whale (**Table 10.24**). For all other receptors, the magnitude is assessed as **negligible**.

Table 10.23 The predicted effect ranges for PTS in all receptors for the cumulative exposure (SEL_{cum} / $L_{E,p,t}$) of both monopiles and pin-piles

Species	Maximum impact range and area for monopiles (*at 6,600 kJ*)	Maximum impact range and area for pin-piles (at *4,400 kJ*)
Harbour porpoise (VHF)	8 km (120 km^2)	3.7 km (30 km^2)
Delphinids (HF)	<0.05 km (<0.01 km^2)	<0.05 km (<0.01 km^2)
Mysticetes (LF)	27 km (1,100 km^2)	16 km (490 km^2)
Pinnipeds (PCW)	<0.05 km (<0.01 km^2)	<0.05 km (<0.01 km^2)
Leatherback Turtle*	<0.05 km (<0.01 km^2)	<0.05 km (<0.01 km^2)
** Leatherback turtle impact assessments are assessed using delphinid magnitudes and significance of effect.*		

Table 10.24 Maximum number of individuals (and % of reference population) that could be at exposed to PTS from cumulative SEL / $L_{e,p}$ of a single installation of monopiles and pin-piles at the maximum hammer energy

Species	Monopile (6,600 kJ)		Pin-pile (4,400 kJ)	
	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)
Harbour porpoise	50 (0.2% WS MU)	Medium	13 (0.05% WS MU)	Medium
Bottlenose dolphin	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin	<1 (0.00001% CGNS MU)	Negligible	<1 (0.00001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000002% CGNS MU)	Negligible	<1 (0.000002% CGNS MU)	Negligible
White-beaked dolphin	<1 (0.000008% CGNS MU)	Negligible	<1 (0.000008% CGNS MU)	Negligible
Risso's dolphin	<1 (0.000001% CGNS MU)	Negligible	<1 (0.000001% CGNS MU)	Negligible
Killer whale	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA))
Long-finned pilot whale	<1 (0.0000002% CGNS MU)	Negligible	<1 (0.0000002% CGNS MU)	Negligible

Species	Monopile (6,600 kJ)		Pin-pile (4,400 kJ)	
	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)
Minke whale	154 (1.5% CGNS MU)	High	103 (1.0% CGNS MU)	High
Fin whale	2 (0.6 % NA)	Medium	1 (0.03% NA)	Medium
Humpback whale	N/A	Medium	N/A	Medium
Grey seal*	<1 (0.00005% WS MU & 0.00002% Wider MU)	Negligible (negligible)	<1 (0.00005% WS MU & 0.00002% Wider MU)	Negligible (negligible)
Harbour seal*	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)
Leatherback Turtle	N/A	Negligible	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.5.2.2.1.3 Permanent Threshold Shift from Cumulative Exposure for Sequential Pin-Pile Installation

138. **Table 10.25** presents the predicted cumulative PTS impact ranges for the sequential installation of pin-piles within a 24-hour period (note that monopiles will not be installed sequentially). Up to six pin-piles may be installed sequentially in a single day. The largest predicted PTS range is for mysticetes, reaching 20 km for six sequential pin-piles (**Table 10.25**).

139. For delphinids, the predicted cumulative PTS range is less than 50 m, meaning PTS is not expected as sound levels remain below auditory injury thresholds. However, a precautionary impact area of 0.01 km² has been applied in the assessment (**Table 10.25**).

140. The magnitude for PTS from sequential pin-pile installation is assessed as **high** for minke whale, **medium** for harbour porpoise, fin whale and humpback whale and **negligible** for all other receptors (**Table 10.26**).

Table 10.25 The predicted effect ranges for PTS in all marine mammal species, for the cumulative exposure of six pin-piles being installed sequentially in 24-hours

Species	Maximum impact range and area for pin-piles
Harbour porpoise (VHF)	5.4 km (47 km^2)
Delphinids (HF)	<0.05 km (<0.01 km^2)
Mysticetes (LF)	21 km (610 km^2)
Pinnipeds (PCW)	<0.05 km (<0.01 km^2)
Leatherback Turtle*	<0.05 km (<0.01 km^2)

Table 10.26 Maximum number of individuals (and % of reference population) that could be exposed to PTS From cumulative SEL/ $L_{E,p}$ from the sequential Installation of pin-piles at the maximum hammer energy

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)
Harbour porpoise	20 (0.08% WS MU)	Medium
Bottlenose dolphin	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin	<1 (0.00001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000002% CGNS MU)	Negligible
White-beaked dolphin	<1 (0.000008% CGNS MU)	Negligible
Risso's dolphin	<1 (0.000001% CGNS MU)	Negligible
Killer whale	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
Long-finned pilot whale	<1 (0.0000002% CGNS MU)	Negligible
Minke whale	128 (1.2% CGNS MU)	High
Fin whale	1 (0.04% NA)	Medium
Humpback whale	N/A	Medium
Grey seal*	<1 (0.00005% WS MU & 0.00002% Wider MU)	Negligible (negligible)
Harbour seal*	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)
Leatherback Turtle	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*		

10.12.1.5.3 Impact 3b: Temporary Auditory Injury (TTS) due to Impact Piling

141. TTS can occur in marine animals from acute exposure to underwater noise, such as a single, intense hammer strike (SPL_{peak} / $L_{p,pk}$) during piling activities. It may also arise from prolonged exposure to elevated underwater noise levels throughout pile installation (SEL_{cum} / $L_{E,p,t}$).

142. The modelling results for the potential onset of instantaneous TTS from the first hammer strike and from a single strike at maximum hammer energy for the installation of monopiles and pin-piles are provided in **Appendix 10.1 Underwater Noise Modelling Report** and **Table 10.27.**

10.12.1.5.3.1 Sensitivity

143. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.5.3.2 Magnitude of Impact

10.12.1.5.3.2.1 Construction

10.12.1.5.3.2.1.1 Temporary Threshold Shift from Single Strike

144. **Table 10.27** presents the predicted effect ranges and areas for instantaneous TTS from a single strike at maximum hammer energy. Harbour porpoise shows the greatest predicted effect, with maximum TTS ranges of 1.2 km for monopiles and 860 m for pin-piles.

145. Overall, the magnitude for all receptors for any instantaneous TTS from piling is assessed as negligible for the installation of monopiles and pin-piles (**Table 10.28**).

Table 10.27 Predicted TTS impact ranges (and areas) from first strike and single strike SPL_{peak} / L_{p-pk} at maximum hammer energy for monopiles and pin-piles

Species	Impact	Maximum impact range and area for monopiles	Maximum impact range and area for pin-piles
Harbour porpoise (VHF)	TTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	1.2 km ($4.7\ km^2$)	0.9 km ($2.5\ km^2$)
	TTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	2.4 km ($17\ km^2$)	1.9 km ($11\ km^2$)
Delphinids (HF)	TTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.05 km ($<0.01\ km^2$)	0.05 km ($<0.01\ km^2$)
	TTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.05 km ($<0.01\ km^2$)	0.05 km ($<0.01\ km^2$)
Mysticetes (LF)	TTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.1 km ($0.03\ km^2$)	0.07 km ($0.02\ km^2$)
	TTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.19 km ($0.11\ km^2$)	0.15 km ($0.07\ km^2$)
Pinnipeds (PCW)	TTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.11 km ($0.04\ km^2$)	0.08 km ($0.02\ km^2$)
	TTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.22 km ($0.15\ km^2$)	0.17 km ($0.1\ km^2$)
Leatherback Turtle*	TTS from first strike at 550 kJ (*at 550 kJ for monopolies and 450 kJ for pin-piles*)	0.02 km ($<0.01\ km^2$)	0.01 km ($<0.01\ km^2$)
	TTS from single strike at full energy *(6,600 kJ for monopolies and 4,440 kJ for pin-piles)*	0.04 km ($<0.01\ km^2$)	0.03 km ($<0.01\ km^2$)
**HF impact ranges applied due to similar thresholds*			

Table 10.28 Assessment of the potential for instantaneous TTS due to a first single strike and single strike (SPL_{peak} / $L_{p\text{-}pk}$) of the maximum hammer energy for a monopile and pin-pile

Species	Impact	Monopiles (*first strike at 550 kJ, full energy 6,600 kJ*)		Pin-piles (*first strike at 450 kJ, full energy 4,400 kJ*)	
		Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour porpoise	TTS from first strike	2 (0.008% WS MU)	Negligible	1 (0.004% WS MU)	Negligible
	TTS from single strike at full energy	7 (0.03% WS MU)	Negligible	5 (0.02% WS MU)	Negligible
Bottlenose dolphin	TTS from first strike	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
	TTS from single strike at full energy				
Common dolphin	TTS from first strike	<1 (0.00001% CGNS MU)	Negligible	<1 (0.00001% CGNS MU)	Negligible
	TTS from single strike at full energy				
Atlantic white-sided dolphin	TTS from first strike	<1 (0.000002% CGNS MU)	Negligible	<1 (0.000002% CGNS MU)	Negligible
	TTS from single strike at full energy				
White-beaked dolphin	TTS from first strike	<1 (0.000008% CGNS MU)	Negligible	<1 (0.000008% CGNS MU)	Negligible
	TTS from single strike at full energy				
Risso's dolphin	TTS from first strike	<1 (0.000001% CGNS MU)	Negligible	<1 (0.000001% CGNS MU)	Negligible
	TTS from single strike at full energy				
Killer whale	TTS from first strike	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
	TTS from single strike at full energy				
Long-finned pilot whale	TTS from first strike	<1 (0.0000002% NA)	Negligible	<1 (0.0000002% NA)	Negligible

Species	Impact	Monopiles (*first strike at 550 kJ, full energy 6,600 kJ*)		Pin-piles (*first strike at 450 kJ, full energy 4,400 kJ*)	
		Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (temporary)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (temporary)**
	TTS from single strike at full energy				
Minke whale	TTS from first strike	<1 (0.00006% CGNS MU)	Negligible	<1 (0.00004% CGNS MU)	Negligible
	TTS from single strike at full energy	<1 (0.0002% CGNS MU)	Negligible	<1 (0.0001% CGNS MU)	
Fin whale	TTS from first strike	<1 (0.000002% NA)	Negligible	<1 0.000001% NA)	Negligible
	TTS from single strike at full energy	<1 (0.000007% NA)	Negligible	<1 0.000004% NA)	
Humpback whale	TTS from first strike	N/A	Negligible	N/A	Negligible
	TTS from single strike at full energy	N/A	Negligible	N/A	Negligible
Grey seal*	TTS from first strike	<1 (0.0002% WS MU & 0.00007% Wider MU)	Negligible (negligible)	<1 (0.0001% WS MU & 0.00003% Wider MU)	Negligible (negligible)
	TTS from single strike at full energy	<1 (0.0007% WS MU & 0.0003% Wider MU)	Negligible (negligible)	<1 (0.0005% WS MU & 0.0002% Wider MU)	
Harbour seal*	TTS from first strike	<1 (0.00001% WS MU & 0.000009% Wider MU)	Negligible (negligible)	<1 (0.000008% WS MU & 0.000005% Wider MU)	Negligible (negligible)
	TTS from single strike at full energy	<1 (0.00006% WS MU & 0.00003% Wider MU)	Negligible (negligible)	<1 (0.00004% WS MU & 0.00002% Wider MU)	
Leatherback Turtle	TTS from first strike	N/A	Negligible	N/A	Negligible
	TTS from single strike at full energy	N/A	Negligible	NA	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*					

10.12.1.5.3.2.1.2 Temporary Threshold Shift from Cumulative Exposure for Single Pile Installation

146. **Table 10.29** presents the predicted TTS impact ranges from cumulative exposure from single piling events (both monopiles and pin-piles).

147. For delphinids, the predicted cumulative TTS range is less than 50 m, indicating that TTS is not expected because sound levels do not exceed the hearing threshold. However, as a precautionary measure, delphinids have been assessed using an impact area of 0.01 km² (**Table 10.29**).

148. The largest predicted cumulative TTS effect ranges occur for mysticetes. For a single 24-hour installation, cumulative TTS ranges are estimated at 120 km for monopiles and 94 km for pin-piles (**Table 10.29**).

149. Although **Table 10.29** indicates very large predicted TTS ranges for mysticetes, these values are considered highly precautionary. The TTS ranges associated with piling presented in **Table 10.29** are considered highly conservative and unlikely to occur in reality. TTS thresholds are inherently precautionary, and this has been discussed in detail by Southall (2021), who notes that when onset criteria are applied to high-intensity impulsive sources (e.g. pile driving), TTS onset may be predicted at distances of tens of kilometres. However, in practice, acoustic propagation over such ranges substantially alters the impulsive signal in both time and frequency (Hastie et al., 2019; Amaral et al., 2020; Martin et al., 2020). These changes include slower signal onset, increased signal duration, reduced crest factor and kurtosis, and a narrowing of bandwidth due to reduced high-frequency content. Accounting for these propagation-related effects can therefore avoid overly precautionary conclusions, although Southall (2021) acknowledges that robust methods for doing so remain challenging. The importance of this issue is reinforced by the conclusion that the application of impulsive exposure criteria at large ranges (tens of kilometres) is almost certainly overly precautionary. As such, it is considered highly unlikely that predicted PTS or TTS ranges extending into the tens of kilometres represent realistic outcomes for impulsive noise exposure (Southall, 2021).

Table 10.29 The predicted effect ranges for TTS in all marine mammal species for the cumulative exposure (SEL_{cum} / $L_{E,p,t}$) of both monopiles and pin-piles (at 6,600 kJ for monopolies and 4,400 kJ for pin-piles)

Species	Maximum impact range and area for monopiles	Maximum impact range and area for pin-piles
Harbour porpoise (VHF)	71 km (5,500 km^2)	50 km (3,500 km^2)
Delphinids (HF)	<0.05 km (<0.01 km^2)	<0.05 km (<0.01 km^2)
Mysticetes (LF)	120 km (15,000 km^2)	95 km (9,800 km^2)
Pinnipeds (PCW)	31 km (1,300 km^2)	21 km (740 km^2)
Leatherback Turtle	<0.05 km (<0.01 km^2)	<0.05 km (<0.01 km^2)

150. The magnitude of cumulative TTS impact from the installation of a single monopile without mitigation is assessed as **high** for minke whale, **medium** for harbour porpoise and grey seal (WS MU) and **low**

for the wider grey seal MU. For all other receptors, the magnitude for TTS from cumulative exposures of a single monopile installation is assessed as **negligible** (**Table 10.30**).

151. The potential of TTS from the installation of a single pin-pile is assessed as **high** for minke whale, **medium** for harbour porpoise and **low** for grey seal (WS and wider MU). For all other receptors, the magnitude for TTS from cumulative exposures of a single pin-pile installation is assessed as **negligible** (**Table 10.30**).

Table 10.30 Maximum number of individuals (and % of reference population) that could be exposed to TTS From cumulative SEL / LE,p of a single Installation of monopiles and pin-pile at the maximum hammer energy

Species	Monopile (6,600 kJ)			Pin-pile (4,400 kJ)
	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour porpoise	2,310 (9.5% WS MU)	Medium	1,470 (6.0% WS MU)	Medium
Bottlenose dolphin*	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.001% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin	<1 (0.00001% CGNS MU)	Negligible	<1 (0.00001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000002% CGNS MU)	Negligible	<1 (0.000002% CGNS MU)	Negligible
White-beaked dolphin	<1 (0.000008% CGNS MU)	Negligible	<1 (0.000008% CGNS MU)	Negligible
Risso's dolphin	<1 (0.000001% CGNS MU)	Negligible	<1 (0.000001% CGNS MU)	Negligible
Killer whale*	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
Long-finned pilot whale	<1 (0.000002% CGNS MU)	Negligible	<1 (0.0000002% CGNS MU)	Negligible
Minke whale	3,150 (30.6% CGNS MU)	High	2,058 (20.0% CGNS MU)	High
Fin whale	30 (0.9% NA)	Negligible	20 (0.6% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible
Grey seal*	1,125 (6.4% WS MU & 2.2% Wider MU)	Medium (Low)	640 (3.7% WS MU & 1.3% Wider MU)	Low (low)
Harbour seal*	104 (0.5% WS MU & 0.3% Wider MU)	Negligible (negligible)	59 (0.3% WS MU & 0.2% Wider MU)	Negligible (negligible)
Leatherback Turtle	N/A	Negligible	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.5.3.2.1.3 Temporary Threshold Shift from Cumulative Exposure for Sequential Pin-Pile Installation

152. **Table 10.31** presents the predicted TTS impact ranges from cumulative exposure during the sequential installation of pin-piles within a 24-hour period. Up to six pin-piles may be installed sequentially in a single 24-hour window. The largest predicted TTS impact range is for mysticetes, at 120 km (**Table 10.31**).

153. For delphinids, the predicted cumulative TTS range is less than 50 m, indicating that TTS is not expected because sound levels do not exceed the hearing threshold. However, as a precautionary approach, delphinids have been assessed using an impact area of 0.01 km² (**Table 10.31**).

Table 10.31 The predicted effect ranges for TTS in all marine mammal species, for the cumulative exposure of six pin-piles being installed sequentially in 24-hours

Species	Maximum impact range (and area) for pin-piles
Harbour porpoise (VHF)	71 km (4,900 km^2)
Delphinids (HF)	<0.05 km (<0.01 km^2)
Mysticetes (LF)	120 km (13,000 km^2)
Pinnipeds (PCW)	28 km (940 km^2)
Leatherback Turtle	<0.05 km (<0.01 km^2)

154. The potential magnitude of TTS from the installation of six pin-piles sequentially without mitigation is assessed as **high** for minke whale, **medium** for harbour porpoise and **low** for grey seal (WS and wider MU). For all other receptors, the magnitude is assessed as **negligible** (**Table 10.32**).

Table 10.32 Maximum number of individuals (and % of Reference Population) that could be exposed to TTS From cumulative SEL / $L_{E,p}$ from the sequential Installation of six pin-piles at the maximum hammer energy

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour porpoise	2,058(8.6% WS MU)	Medium
Bottlenose dolphin*	<1 (0.0009% CWSH MU & 0.00003% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin	<1 (0.00001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000001% CGNS MU)	Negligible
White-beaked dolphin	<1 (0.000008% CGNS MU)	Negligible
Risso's dolphin	<1 (0.000001% CGNS MU)	Negligible
Killer whale*	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
Long-finned pilot whale	<1 (0.0000002% CGNS MU)	Negligible
Minke whale	2,730 (26.5% CGNS MU)	High
Fin whale	26 (0.8% NA)	Negligible
Humpback whale	N/A	Negligible
Grey seal*	813 (4.7.% WS MU & 1.62% Wider MU)	Low (low)

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour seal*	75 (0.4% WS MU & 0.2% Wider MU)	Negligible (negligible)
Leatherback Turtle	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*		

10.12.1.5.4 Significance of Effect

10.12.1.5.4.1 PTS

155. For the potential for PTS from piling, embedded mitigation includes;

- Standard mitigations as set out in JNCC (2010) guidelines for minimising the risk of injury to marine mammals from piling noise, such as pre-piling watches with MMO and/or PAM, soft-start and use of ADDs (see **Table 10.8**; M-6 and **Appendix 9 Draft MMMP**).

156. The effect significance for auditory injury (PTS) based on the quantitative assessment from the first strike and a single strike at maximum hammer energy for both the installation of monopiles and pin-piles, prior to accounting for embedded mitigation, is presented in **Table 10.33.** For all receptors, sensitivity is **high** (**Table 10.14**), and the magnitude is assessed as **negligible**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.33**).

157. For permanent auditory injury from cumulative exposure to the installation of monopiles, pin-piles, and cumulative exposure of six sequential pin-piles, minke whale has been assessed as having a **high** magnitude and for harbour porpoise, fin whale and humpback whale the magnitude is assessed as **medium**. However, this is without accounting for embedded mitigation as noted above (see **Appendix 9 Draft MMMP**), and is deemed to be over precautionary, as described in **Paragraph 149** since underwater noise from piling propagates over many kilometres, scattering and energy loss rapidly reducing its impulsive characteristics. So at distances over 10 km the sound is no longer fully impulsive and is therefore not expected to result in harmful effects on cetaceans. Furthermore, as described in **Appendix 9 Draft MMMP**, the Lofitech seal scarer is proven to deter harbour porpoise at distances of 7 km (Brandt et al., 2012; Brandt et al., 2013; Gordon et al., 2015; Graham et al., 2023). Therefore, using professional judgement and accounting for the level of impulsiveness of the sound, and the embedded mitigation to ensure no instantaneous PTS occurs as presented in **Appendix 9 Draft MMMP**, the significance of effect is considered as **minor adverse**, for harbour porpoise, minke whale, fin and humpback whale, which is **not significant** in EIA terms (**Table 10.33**). The magnitude of impact is **negligible** for all other receptors, resulting in a **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.33**).

10.12.1.5.4.2 TTS

158. There is no embedded mitigation specifically designed for the potential for TTS from piling. However, while the embedded mitigation for PTS, as set out in **paragraph 155** above, would not mitigate for all TTS effects, it would reduce the effect by ensuring marine mammals are deterred from the area prior to piling.

159. The effect significance for auditory injury (TTS) from a single strike for first strike and at maximum hammer energy for both the installation of monopiles and pin-piles is presented in **Table 10.33**. For all receptors, it is predicted that sensitivity of the receptor is medium. For TTS from a single strike (at

starting and maximum hammer energy), the magnitude is assessed as **negligible**, resulting in **negligible adverse** significance, which is **not significant** in EIA terms (**Table 10.33**).

160. For temporary auditory injury from cumulative exposure to the installation of a single monopile, the magnitude is assessed as **high** for minke whale which would result in a major adverse effect. The magnitude is assessed as **medium** for harbour porpoise and grey seal (WS MU), resulting in a **moderate adverse** effect, which is significant in EIA terms. However, as described in **Paragraph 149**, this magnitude is considered over precautionary due to the reduction in impulsiveness of the sound at distances greater than 10 km. The sound is very unlikely to be impulsive at 70 or 120 km from the source. Therefore, the significance of effect has been assessed as **minor adverse**, which is **not significant** in EIA terms. The magnitude is assessed as **low** for the wider grey seal MU; resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms (**Table 10.33**).

161. For TTS from the installation of a single pin-pile and six pin-piles sequentially, the magnitude is assessed as **high** for minke whale; and **medium** for harbour porpoise. However, as above, at distances of many kilometres from the source, the impulsive characteristics of piling noise rapidly diminish. Therefore, the significance of effect has been assessed as **minor adverse** for both harbour porpoise and minke whale, which is **not significant** in EIA terms. The magnitude is assessed as **low** for grey seal (WS and wider MU), resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude for TTS from cumulative exposure of a single pin-pile installation is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms (**Table 10.33**).

10.12.1.5.4.3 Designated Sites

162. As shown in **Table 10.7**, there are a number of marine mammal designated sites that may be affected by piling at the WDA. For harbour porpoise, the SAC populations (of the Inner Hebrides and the Minches and Skerries and Causeway SACs) are part of the WS MU, which is the focus of the harbour porpoise assessment provided in this EIAR. There would be no significant effect on the harbour porpoise populations of either SAC, as there is no significant effect on the WS MU due to underwater noise emitted from piling, as shown by **Table 10.33** below.

163. For minke whale, there is one designated site that may be affected by piling at the WDA; the Sea of the Hebrides NCMPA. Based on the NCMPA specific minke whale density, as presented in the **Report to Inform Marine Protected Area Assessment**, up to 39 minke whale may be at risk of PTS onset, and up to 530 at risk of TTS, equating to 1.6% and 21.5% of the NCMPA population respectively. However, with embedded mitigation, and taking into account the unrealistic impact ranges this is based on as noted above, this would not equate to a significant effect in EIA terms (**Table 10.33**).

164. For pinnipeds, there are a number of designated sites that may be affected by piling at the WDA; Treshnish Isles SAC (for grey seal), and South-East Islay Skerries, Eileanan agus Sgeiran Lios mor, Sound of Barra and Ascrib, Isay and Dunvegan SACs, all designated for harbour seal. These SAC populations are part of the wider population, which is assessed as part of the EIA assessments. As there are no significant effects on the wider population of seals, there would also not be any significant effect to grey or harbour seal of any of the above listed designated sites (**Table 10.33**).

Table 10.33 Significance of effect from the potential for auditory injury (PTS and TTS) due to the installation of monopiles and pin-piles to marine mammals and Leatherback Turtle (blue shaded cells = with embedded mitigation)

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Auditory Injury (PTS) from single strike	All marine mammals	High	Negligible	Minor adverse	N/A	Not significant
Auditory Injury (PTS) from cumulative exposure for a single monopile or pin-pile installation	Harbour porpoise, fin whale & humpback whale		Medium	Minor adverse[7]	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin & long-finned pilot whale		Negligible	Minor adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Minor adverse (minor adverse)	N/A	Not significant
	Minke whale		High	Minor adverse	N/A	Not significant
	Leatherback Turtle		Negligible	Minor adverse	N/A	Not significant
Auditory Injury (PTS) due to sequential piling of pin-piles from cumulative exposure	Harbour porpoise, fin whale & humpback whale	High	Medium	Minor adverse	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)

[7]See **Section 10.12.1.5.4.1** for more information on concluding significance of effect for harbour porpoise and mysticetes.

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin & long-finned pilot whale		Negligible	Minor adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Minor adverse (minor adverse)	N/A	Not significant
	Minke whale		High	Minor adverse[7]	N/A	Not significant
	Leatherback Turtle		Negligible	Minor adverse	N/A	Not significant
Auditory Injury (TTS) from single strike	All marine mammals	Medium	Negligible	Negligible adverse	N/A	Not significant
Auditory Injury (TTS) from cumulative exposure for a single monopile installation	Harbour porpoise	Medium	Medium	Minor adverse[8]	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Minke whale		High	Minor adverse[8]	N/A	Not significant

[8]Due to information presented in **Section 10.12.1.5.4.2**, assigning the magnitude as high (and therefore significance of effect as moderate adverse) is considered over precautionary due to the reduction in impulsiveness of the sound at distances greater than 10 km. The sound is very unlikely to be impulsive at 70 or 120 km from the source.

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
	Grey seal*		Medium (Low)	Minor adverse [8] (minor adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback Turtle		Negligible	Negligible adverse	N/A	Not significant
Auditory Injury (TTS) due to cumulative exposure to a single pin-pile installation and/or sequential piling of six pin-piles from cumulative exposure	Harbour porpoise	Medium	Medium	Minor adverse[8]	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Minke whale		High	Minor adverse[8]	N/A	Not significant
	Grey seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse	N/A	Not significant
	Leatherback Turtle		Negligible	Negligible adverse	N/A	Not significant
**Magnitudes and significance of effect in brackets are for the wider reference populations used in the assessment*						

10.12.1.6 Impact 4: Disturbance and Behavioural Impacts from Underwater Noise During Piling

165. At present, there is no universally accepted standard for defining noise thresholds or criteria for behavioural responses in marine mammals. As a result, underwater noise modelling cannot reliably predict behavioural impact ranges. To inform this assessment, a desk-based literature review has been undertaken to explore the potential for disturbance and to estimate indicative impact ranges from underwater noise generated during piling. Consequently, underwater noise modelling has not been used to predict impact ranges for behavioural effects.

166. Assessing the likelihood of disturbance requires evaluating whether noise exposure may provoke behavioural responses that could lead to significant population-level effects. This is challenging due to the variability of underwater sound propagation and the differing sensitivities and behaviours among species and individuals. Guidance from JNCC et al. (2010) indicates that any activity likely to increase the risk of long-term population decline may constitute disturbance under relevant regulations. According to this guidance, a behavioural response severity score of 5 or above on the Southall et al. (2007) scale may represent a significant effect, as more severe responses reflect reduced tolerance and may interfere with vital life functions.

167. Behavioural reactions to underwater noise can vary widely, including orienting towards or avoiding the sound source, increased vigilance, changes in vocalisation, interruption of feeding or social behaviour, altered movement or diving patterns, temporary or permanent habitat displacement, and, in extreme cases, injury or mortality (Southall et al., 2007). It is important to note that a behavioural response does not necessarily indicate avoidance of the area.

10.12.1.6.1.1 Sensitivity

168. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.6.2 Magnitude of Impact

10.12.1.6.2.1 Construction

169. Potential disturbance of marine mammals from underwater noise during piling has been assessed in this section using different methods for each species (**Table 10.34**). For the assessment of piling-related disturbance, humpback whale has been assessed by proxy following fin whale, while leatherback turtle has been assessed by proxy following delphinids (killer whale (NA) and long-finned pilot whale), reflecting similar PTS/TTS thresholds and the rare occurrence of these receptors within the Study Area.

Table 10.34 Overview of available and applied assessment methods for marine mammal species considered for the disturbance assessment

Method	Harbour porpoise	Delphinid	Mysticetes	Pinnipeds
Dose-Response Curve (DRC)	✓	✓ (Applying the harbour porpoise DRC as a proxy)	✓ (Applying the harbour porpoise DRC as a proxy)	✓
Deterrent Distance-base function	✓			

Method	Harbour porpoise	Delphinid	Mysticetes	Pinnipeds
Effective Deterrent Range	✓	✓ (Applying JNCC (2025) EDRs for harbour porpoise)	✓ (Applying JNCC (2025) EDRs for harbour porpoise)	✓ (Applying JNCC (2025) EDRs for harbour porpoise)
Interim population consequences of disturbance (iPCoD) (**Section 10.12.1.6.3.1**)	✓	✓ (bottlenose dolphin only)	✓ (minke whale only)	✓

170. Population modelling (iPCoD) was available for harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal. The total number of animals disturbed has been derived from the EDR assessments representing a realistic worst case (see final model parameters in **Appendix 10.4 iPCoD**).

10.12.1.6.2.1.1 Dose Response Curve Assessment

171. Recent developments in acoustic impact assessment have emphasised the value of dose-response curves (DRCs) for estimating the number of marine mammals potentially affected by underwater noise. Unlike traditional threshold-based approaches, which assume uniform behavioural responses across all individuals within an exposure zone, DRCs offer an approach that accounts for variation in response depending on the received dose of sound energy (Dunlop et al., 2017).

172. In this assessment, the dose is represented by the single-strike sound exposure level (SEL_{ss} / $L_{E,p,ss}$), which quantifies the energy from an individual piling strike. The use of SEL_{ss} / $L_{E,p,ss}$ in dose-response modelling is increasingly recognised as best practice, as outlined in guidance from Southall et al. (2021) and supported by NOAA Fisheries' 2024 Technical Guidance (Southall et al., 2021; NOAA, 2024). This approach acknowledges that behavioural responses are not uniform and vary by species, individual sensitivity, and environmental context.

173. The dose-response methodology has been applied across all proposed piling locations, with the highest estimated number of individuals disturbed presented as a precautionary measure. Species assessed were harbour porpoise, all delphinids, minke whale, fin whale, grey seal and harbour seal. The corresponding percentages of the relevant MU populations potentially affected are summarised in **Table 10.35**.

174. Subsequent studies revealed that the responses of harbour porpoises to piling noise diminished over the construction period (Graham et al., 2019). Therefore, applying the dose-response relationship from an initial piling event to all piling events in the marine mammal assessment is considered conservative.

175. It is important to note that the DRCs used were developed primarily for harbour porpoise, a species with VHF hearing sensitivity. Applying these curves to other cetaceans, such as delphinids (HF) and mysticetes (LF), introduces a bias due to differences in auditory sensitivity and behavioural ecology (Southall et al., 2021). Additionally, this analysis focuses solely on pile-driving noise and does not account for the potential mitigating effects of ADDs, which may reduce local marine mammal densities prior to piling. As such, the results presented here should be considered precautionary. Further information on the DRC method is presented in **Appendix 10.4 iPCoD Modelling Technical Report**.

176. Recent findings have indicated predictions of disturbance based on dose response are overly precautious, leading assessments to be unrealistic. The following section outlines a more recent approach to disturbance assessment (the deterrence function), based on the latest science and understanding of the effect of piling on harbour porpoise. Both the dose response and deterrence function assessments have been undertaken, however, when interpreting the results of assessments, it is important to remember that the deterrence function is the more realistic approach.

177. It is not possible to assess humpback whale and leatherback turtle quantitatively due to a lack of data. However, fin whale will be used as a proxy for humpback whale and delphinid species (killer whale (NA and long-finned pilot whale) will be used for leatherback turtles due to the similarity in PTS/TTS thresholds.

178. **Table 10.35** presents the numbers of animals that could be disturbed due to a single piling event using the DCR. The magnitude for disturbance is assessed as **high** for harbour porpoise, bottlenose dolphin (CWSH and OW), white-beaked dolphin, killer whale (WCC) and grey seal (WS MU). The magnitude is assessed as **medium** for Atlantic white-sided dolphin, minke whale, grey seal (Wider MU) and harbour seal (WS MU). For common dolphins and harbour seal (wider MU), the magnitude is assessed as **low** and for Risso's dolphin, killer whale (NA), long-finned pilot whale and fin whale the magnitude is assessed as **negligible**.

10.12.1.6.2.1.2 Deterrent distance-based function

179. The PrePARED project compared observed responses of harbour porpoises to pile driving noise at the Moray West wind farm with predictions made during earlier regulatory assessments (Thompson et al., 2025). Comparisons indicated the Graham et al. (2017) dose-response function resulted in highly conservative predictions of disturbance. In the Moray West regulatory assessments, over 4,500 harbour porpoises were predicted to be disturbed by a single piling event, based on dose response (Moray West, 2023). However, during construction monitoring at Moray West it was indicated disturbance of harbour porpoise was more likely to have impacted less than 100 individuals (Thompson et al. 2025). Observations made at Moray West across the 35 km range of overlap also highlighted that observations were better predicted by the Graham et al. (2019) deterrence function than the recommended dose-response function.

180. Therefore, this new evidence indicates assessments are likely to be more realistic if based on the deterrence distance-based function, derived from the Beatrice Offshore windfarm monitoring data in Graham et al. (2019), instead of the dose response function presented in Graham et al. (2017). Due to this, the deterrence distance-based function was used to calculate disturbance for harbour porpoise to provide a comparison against the predictions using the dose-response model (**Table 10.35**). Further information on the deterrence distance-base function method is presented in **Appendix 10.4 iPCoD Modelling Technical Report**.

181. **Table 10.35** shows the results of both the dose-response model and the deterrence function used to estimate the disturbance predictions for harbour porpoise. Both approaches have used the worst-case piling location. Results indicate a significantly lower amount of harbour porpoise were predicted to be disturbed using the distance-based deterrence function when compared to the results of the dose-response curve assessment. Therefore, the approach taken in the EIA to assess potential disturbance from piling is shown to be overly precautionary for harbour porpoise (and is therefore likely to be overly precautious for other cetacean species).

Table 10.35 Number of individuals (and % of reference population) that could be disturbed during piling of monopiles (without mitigation) based on the dose-response approach for all receptors and deterrent distance-based function for harbour porpoise

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary) without mitigation
Dose-response curve assessment (Graham et al., 2017)		
Harbour porpoise	11,566 (47.6% WS MU)	High
Bottlenose dolphin	1,267 (100% CWSH MU & 97.6% OW MU)	High (CSWH MU & OW MU)
Common dolphin	2,249 (3.9% CGNS MU)	Low
Atlantic white-sided dolphin	832 (6.4% CGNS MU)	Medium
White-beaked dolphin	7,583 (22.3% CGNS MU)	High
Risso's dolphin	81 (0.9% CGNS MU)	Negligible
Killer whale	43 (100% WCC & 0.28% NA)	High (WCC & NA)
Long-finned pilot whale	972 (0.6% NA block)	Negligible
Minke whale	794 (7.7% CGNS MU)	Medium
Fin whale	6 (0.2% NA)	Negligible
Humpback whale	N/A	Negligible
Grey seal*	4,548 (26.0% WS MU & 9.1% Wider MU)	High (medium)
Harbour seal*	1,049 (5.3% WS MU & 3.1% Wider MU)	Medium (low)
Leatherback turtle	N/A	Negligible
Deterrent distance-based function (Graham et al., 2019)		
Harbour porpoise	553 (2.3% WS MU)	Low
**Magnitudes in brackets are for the wider reference populations used in the assessment*		

10.12.1.6.2.1.3 Effective Deterrent Range

182. Two reports, prepared by Brown et al. (2025) and Majewska et al. (2025), evaluated the suitability of existing EDRs and provided recommendations for default values. Both undertook a comprehensive review of the empirical and modelled evidence underpinning current EDRs and, where possible, re-examined available datasets to refine and standardise EDRs. Following these reports, the current advice for England, Wales and Northern Ireland from SNCBs (JNCC, DEARA, and Natural England) has been updated (JNCC, 2025b). For harbour porpoise, a disturbance range (EDR) of 20 km (1,256.64 km^2) has been advised for piling of monopiles and pin-piles without noise abatement (JNCC, 2025b).

183. Although there is limited information on behavioural responses for several receptors, available research indicates that delphinids are less sensitive to underwater noise than harbour porpoise. This was demonstrated during construction of the Moray East Offshore Windfarm, where impact piling had no discernible effect on dolphin presence (Fernandez-Betelu et al., 2021). Mysticetes have been recorded to avoid impulsive noise at distances of 20–30 km, as shown by bowhead whale avoidance behaviour described in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**

Report. Pinnipeds have also been documented avoiding piling activity at distances up to 25 km (Russell et al., 2015).

184. Due to limited data and similarities in deterrence ranges, the EDRs for harbour porpoise have been applied to all receptors where a quantitative assessment is possible.

185. For the installation of monopiles and pin-piles, the magnitude of potential disturbance has been assessed as **high** for bottlenose dolphin (CWSH MU) and killer whale (WCC) and **medium** for grey seal (WS MU). For harbour porpoise, bottlenose dolphin (OW MU) and grey seal (wider MU) the magnitude has been assessed as **low**. For all other receptors the magnitude has been assessed as **negligible** (**Table 10.36**).

Table 10.36 EDR assessment for marine mammals for piling (N/A not applicable)

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour porpoise	528 (2.1% WS MU)	Low
Bottlenose dolphin	54 (100% CWSH MU & 4.1% OW MU)	High (CWSH MU) Low (OW MU)
Common dolphin	1,009 (1.8% CGNS MU)	Low
Atlantic white-sided dolphin	28 (0.2% CGNS MU)	Negligible
White-beaked dolphin	320 (0.9% CGNS MU)	Negligible
Risso's dolphin	13 (0.2% CGNS MU)	Negligible
Killer whale	2 (15.7% WCC & 0.008% NA)	High (WCC) Negligible (NA)
Long-finned pilot whale	41(0.03% NA)	Negligible
Minke whale	264 (2.6% CGNS MU)	Low
Fin whale	3 (0.08% NA)	Negligible
Humpback whale	N/A	Negligible
Grey seal*	1,106 (6.4% WS MU & 2.2% Wider MU)	Medium (low)
Harbour seal*	101 (0.5% WS MU & 0.3% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*		

10.12.1.6.2.1.4 Disturbance During Acoustic Deterrent Device Activation

186. To minimise the possibility of PTS in all receptors during piling operations, one recommended mitigation measure is the activation of an ADD prior to soft-start procedures. At this stage, any assessment of potential disturbance caused by ADD activation is indicative only, as final mitigation requirements will be confirmed in the Final MMMP / Piling Noise Mitigation Plan prior to construction. These will be based on the best available evidence and developed in consultation with the relevant SNCBs (JNCC, 2025b).

187. Worst-case cumulative sound exposure level (SEL_{cum} / $L_{E,p,t}$) modelling during the installation of up to 144 monopiles, including soft-start and ramp-up phases, indicates a maximum potential impact range of approximately 27 km for mysticetes. As outlined in **Section 10.12.1.5.2.2**, this estimate is considered highly precautionary. ADD activation alone is unlikely to provide effective mitigation across such a large area for mysticetes. Evidence from McGarry et al. (2017) and Boisseau et al.

(2021) demonstrates that the Lofitech seal scarer influences minke whale behaviour at distances of up to 1 km and 1.5 km from the source, respectively. Within 15 minutes of ADD activation, minke whales were observed to move at least 1.7 km away, with a maximum deterrence range of 4.5 km recorded (Boisseau et al., 2021). Distances beyond this are unlikely to be effective for minke whales and, by extension, other mysticetes. The Lofitech seal scarer has been shown to deter harbour porpoise at minimum ranges of approximately 7 km (Brandt et al., 2012; Brandt et al., 2013; Gordon et al., 2015; Graham et al., 2023), which would result in an ADD activation time of approximately 80 minutes.

188. Consultation with NatureScot (**Table 10.2**) has agreed that SPL_{peak} / $L_{p\text{-}pk}$ should be used to inform ADD activation times, with further consultation post consent when finalising the final MMMP / Piling Noise Mitigation Plan. Scientific literature on cetacean swimming speeds was used to determine the distance animals would need to travel to move beyond the modelled PTS SPL_{peak} / $L_{p\text{-}pk}$ ranges. Scientific literature on receptors swimming speeds was used to determine the distance animals would need to travel to move beyond the modelled PTS SPL_{peak} / $L_{p\text{-}pk}$ ranges.

189. For example, harbour porpoise, with a swimming speed of approximately 1.4 m/s (SNH, 2016) (**Table 10.37**), would require a 15-minute ADD activation period to move beyond a 1 km impact area. A 15-minute activation period would therefore provide a deterrence distance of approximately 1.2 km for harbour porpoise. This duration (15 minutes) would also be sufficient to cover the predicted SPL_{peak} / $L_{p\text{-}pk}$ ranges for delphinids, mysticetes and pinnipeds.

190. For minke whales, assuming a precautionary swimming speed of approximately 2.1 m/s (SNH, 2016; Biology Insights, 2025), an ADD activated for at least 15 minutes would provide an estimated deterrent range of around 1.9 km (**Table 10.37**).

191. Within an activation time of 15 minutes, marine mammals are expected to travel at least 1.2 km and leatherback turtle at least 0.7 km, which is sufficient to move beyond the predicted impact zone (SPL_{peak} / $L_{p\text{-}pk}$) under typical conditions.

192. The final design of the WDA infrastructure will determine the hammer energies and durations used during piling. These may be lower than the maximum values assessed, potentially resulting in reduced impact ranges and shorter required ADD activation times. While the modelled PTS SPL_{peak} / $L_{p\text{-}pk}$ range for harbour porpoise is shown as 1 km (based on the location with the highest predicted effect (SPL_{peak} / $L_{p\text{-}pk}$)), this represents a precautionary maximum (**Table 10.37**).

Table 10.37 Effect ranges of ADD activation for monopiles within PTS SPL_{peak} / $L_{p,pk}$ impact ranges

ADD activation timings	Minke whale, fin whale, humpback whale (LF)*	Delphinids (HF)**	Harbour porpoise (VHF) ***	Pinnipeds (PCW) ^*	Leatherback turtle ^**
Minimum PTS SPL_{peak} / $L_{p,pk}$ impact range (km) (ADD activated for 15 minutes)	1.9	1.3	1.2	1.6	0.7

** based on a swimming speed of 2.1 m/s (SNH, 2016)*

*** based on a swimming speed of 1.52 m/s (Bailey and Thompson, 2006)*

**** based on a swimming speed of 1.4 m/s (SNH,2016)*

^ based on a swimming speed of 1.8 m/s (SNH, 2016)*

*^** base on a swimming speed of 0.8 m/s (Eckert, 2002)*

193. Based on the above, the assessments for disturbance effects during ADD activation is based on a 15-minute ADD activation for monopiles. **Table 10.38** presents the potential area of effect from ADD activation for 15 minutes.

Table 10.38 Area of effect from ADD activation

Species	Add duration	Distance (swim speed) (m/s)	Range (km)	Area (km^2)
Mysticete (LF)	15	2.1	1.9	11.3
Delphinds (HF)	15	1.52	1.3	5.8
Harbour porpoise (VHF)	15	1.4	1.2	4.9
Pinnipeds (PCW)	15	1.8	1.6	8.2
Leatherback turtle	15	0.8	0.7	1.6

194. To assess for disturbance from ADD activation, the recommended EDRs for harbour porpoise published by JNCC, (2025b) have been applied. Two EDRs are advised for ADD activation use; an 11 km (380.13 km^2) EDR for ADD activity greater than 15 minutes, and an 8 km (201.06 km^2) EDR for ADD activity less than 15 minutes.

195. The 11 km EDR is for monopiles and pin-piles installed without noise reduction mitigation. Assessing disturbance from ADD using the 11 km EDR, has resulted in a **high** magnitude for bottlenose dolphin (CWSH MU). This classification is precautionary, primarily due to the small size of the CWSH population, which comprises approximately 45 individuals. Consequently, percentage-based calculations appear disproportionately large when applied to such a limited reference population. Additionally, the assessment assumes that the entire MU would be present within the area during activation of the ADD, a scenario considered highly unlikely. There is currently no empirical evidence regarding the effectiveness of the Lofitech Seal Scarer on delphinids. However, studies on captive bottlenose dolphins have documented startle responses at source levels of 135 dB re 1 µPa RMS (Janik & Götz, 2013). Based on these findings, it may be inferred that an ADD emitting a source level of 190 dB re 1 µPa at HF could potentially deter delphinids over distances exceeding 4 km (McGarry et al., 2017). This range is substantially greater than the area of effect considered in the assessment. Nevertheless, this assumption remains unsubstantiated, as behavioural responses observed in captive environments may differ significantly from those in natural marine conditions.

196. The magnitude is assessed as **low** for bottlenose dolphin (OW MU), common dolphin, killer whale, WCC and grey seal (WS MU). For all other receptors the magnitude is assessed as **negligible** (**Table 10.39**). The magnitude of impact for leatherback turtle follows that of delphinids (killer whale (NA) and long-finned pilot whale) due to similar PTS/TTS thresholds and the species' very rare occurrence within the Study Area.

197. Assessing disturbance from ADD using the 8 km EDR, has resulted in a **high** magnitude for bottlenose dolphin (CWSH MU), and a **low** magnitude for bottlenose dolphin (OW MU), WCC killer whale and grey seal (WS MU). For all other receptors the magnitude is assessed as **negligible** (**Table 10.39**).

Table 10.39 Maximum number of individuals (and % of reference population) that could be disturbed by ADD activation prior to piling based on the JNCC (2025) EDRs

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Harbour porpoise	160 (0.6% WS MU)	Negligible

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
Bottlenose dolphin	54 (36.0% CWSH MU & 1.2% OW MU)	High (CWSH MU) Low (OW MU)
Common dolphin	305 (1.2% CGNS MU)	Low
Atlantic white-sided dolphin	9 (0.7% CGNS MU)	Negligible
White-beaked dolphin	97 (0.3% CGNS MU)	Negligible
Risso's dolphin	4 (0.04% CGNS MU)	Negligible
Killer whale	<1 (4.7% WCC & 0.003% NA)	Low (WCC) Negligible (NA)
Long-finned pilot whale	13 (0.009% NA)	Negligible
Minke whale	80 (0.7% CGNS MU)	Negligible
Fin whale	1 (0.03% NA)	Negligible
Humpback whale	N/A	Negligible
Grey seal*	329 (1.8% WS MU & 0.6% Wider MU)	Low (negligible)
Harbour seal*	30 (0.2% WS MU & 0.1% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*		

10.12.1.6.3 Significance of Effect

10.12.1.6.3.1 Population Modelling

198. Population modelling using the Interim Population Consequence of disturbance (iPCoD) has been undertaken to determine the population consequences of disturbance due to piling at MachairWind (see **Appendix 10.4 iPCoD Modelling Technical Report**).

199. Population modelling for piling has been undertaken for all receptors where parameters are available: harbour porpoise, bottlenose dolphin, minke whale, and grey and harbour seal at the MU scale. Under NRW (2023) guidance, if piling at the WDA were to cause PTS and/or disturbance resulting in a sustained population decline of more than 1% per year (relative to an unimpacted reference population) over a defined period; such as the first six years, reflecting the former FCS reporting cycle; a significant effect cannot be ruled out. NRW's 2023 position statement notes that this threshold can be used to interpret iPCoD outputs for behavioural disturbance, although the guidance is primarily intended for PTS and remains under development. In the absence of alternative direction, applying the 1% threshold to iPCoD results is considered an appropriate and defensible method for interpreting the modelling outputs and informing the assessment. This approach has therefore been adopted.

10.12.1.6.3.1.1 Harbour porpoise

200. The population modelling for harbour porpoise is based on:

- A realistic worst-case of 528 harbour porpoise being disturbed;
    - The potential number of harbour porpoise that could be disturbed from a single monopile installation came from the assessment using EDRs (**Table 10.36**). The EDR approach was used because the DRC produced overly precautionary estimates, while the EDRs

align more closely with the deterrence function and recent evidence. Although still precautionary, the JNCC (2025b) EDRs are considered a more realistic representation of expected responses.

- A total of 51 individuals being at risk of PTS based on:
    - Based on the assessment of PTS (Impact range and number of potential individuals at risk of PTS) (**Table 10.24**)).

201. **Plate 10.1** presents the mean unimpacted and impacted harbour porpoise populations overlaid for comparison. The iPCoD outputs, provided in **Appendix 10.4 iPCoD Modelling Technical Report**, indicate that by 2033, the year piling concludes and five years after disturbance begins, the median ratio of impacted to unimpacted population size is 99.83%, with a mean ratio of 99.44%.

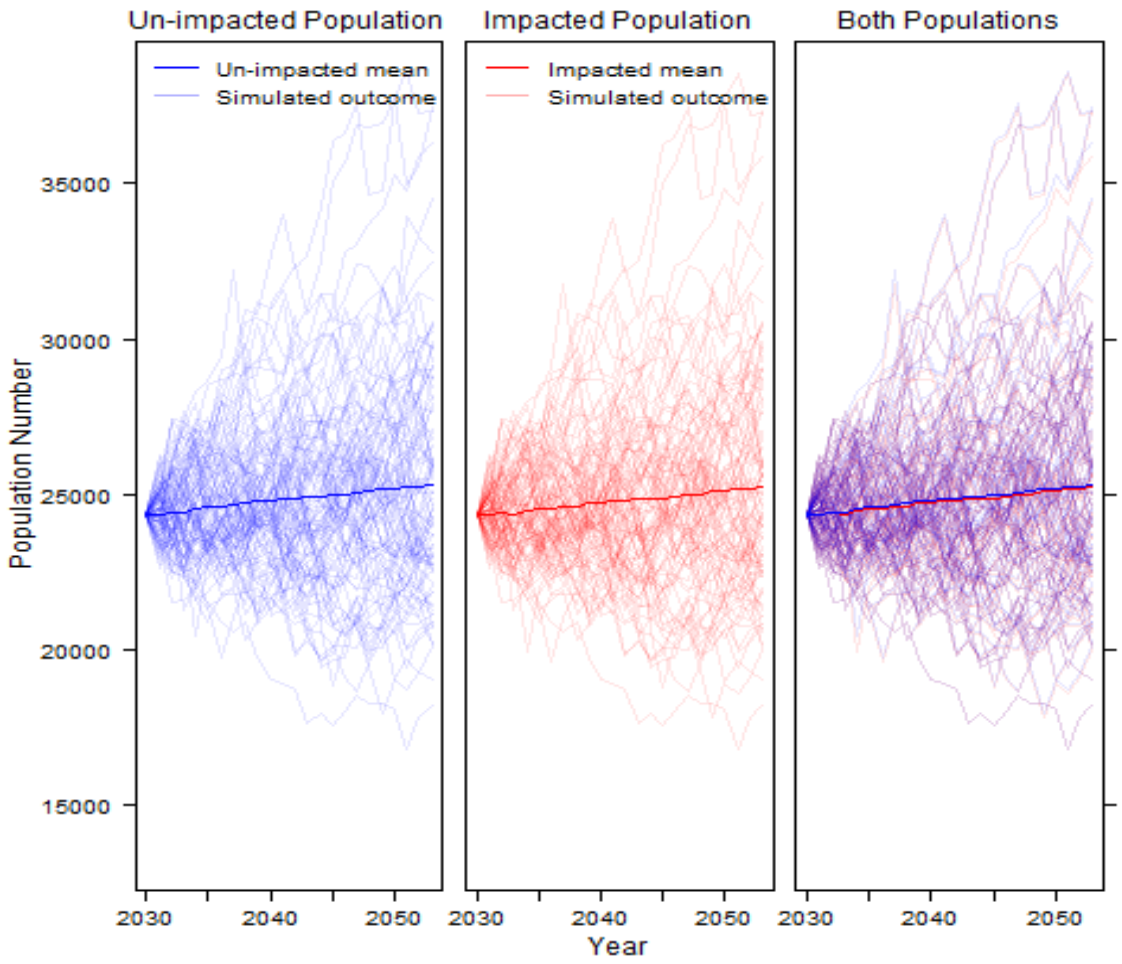


Plate 10.1 Simulated worst-case harbour porpoise population sizes for both the unimpacted and the impacted populations.

202. Beyond 2033, the impacted population follows the same stable trajectory as the unimpacted population through to 2055, resulting in a median ratio of 100.00% and a mean ratio of 100.00% at the modelling end point.

203. As the model predicts less than a 1% annual decline and no difference between the median unimpacted and impacted populations over the 25-year period, the results indicate no significant effect on the harbour porpoise population in response to piling, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

10.12.1.6.3.1.2 Bottlenose dolphin

204. The population modelling for bottlenose dolphin is based on:

- A realistic worst-case of 54 bottlenose dolphin being disturbed;
  - The potential number of bottlenose dolphin that could be disturbed from a single monopile installation came from the assessment using EDRs (**Table 10.36**). The EDR approach was used as described above for harbour porpoise.
- Zero individuals at risk of PTS;
  - Based on the assessment of PTS (Impact range and number of potential individuals at risk of PTS) (**Table 10.24**)).

205. **Plate 10.2** and **Plate 10.3** presents the mean unimpacted and impacted bottlenose dolphin populations overlaid for comparison. The iPCoD outputs, provided in **Appendix 10.4 iPCoD Modelling Technical Report**, indicate that by 2033, the year piling concludes, the median and mean ratio of impacted to unimpacted population size is 90.91% for the CWSH MU and 99.23% and 99.46% for the OW MU.

206. Beyond 2033, the impacted population follows the same stable trajectory as the unimpacted population through to 2055, resulting in a median ratio of 88.89% and a mean ratio of 86.36% for the CWSH MU. For the OW MU, the impacted population follows the same stable trajectory as the unimpacted population through to 2055, resulting in a mean ratio of 99.07% and a median ratio of 99.22% for the OW MU at the modelling end point.

207. The model predicts a greater than a 1% annual decline over the first 6 years and up to 12% difference between the CWSH MU unimpacted and impacted populations over the 25-year period. The results therefore indicate that there is significant effect on the bottlenose dolphin CWSH MU in response to piling, resulting in a potential **moderate adverse** effect, which is significant in EIA terms.

208. As the model predicts less than a 1% annual decline over the first 6 years and less than 1% difference between the unimpacted and impacted populations over the 25-year period. The results indicate no significant effect on the bottlenose dolphin OW MU in response to piling, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

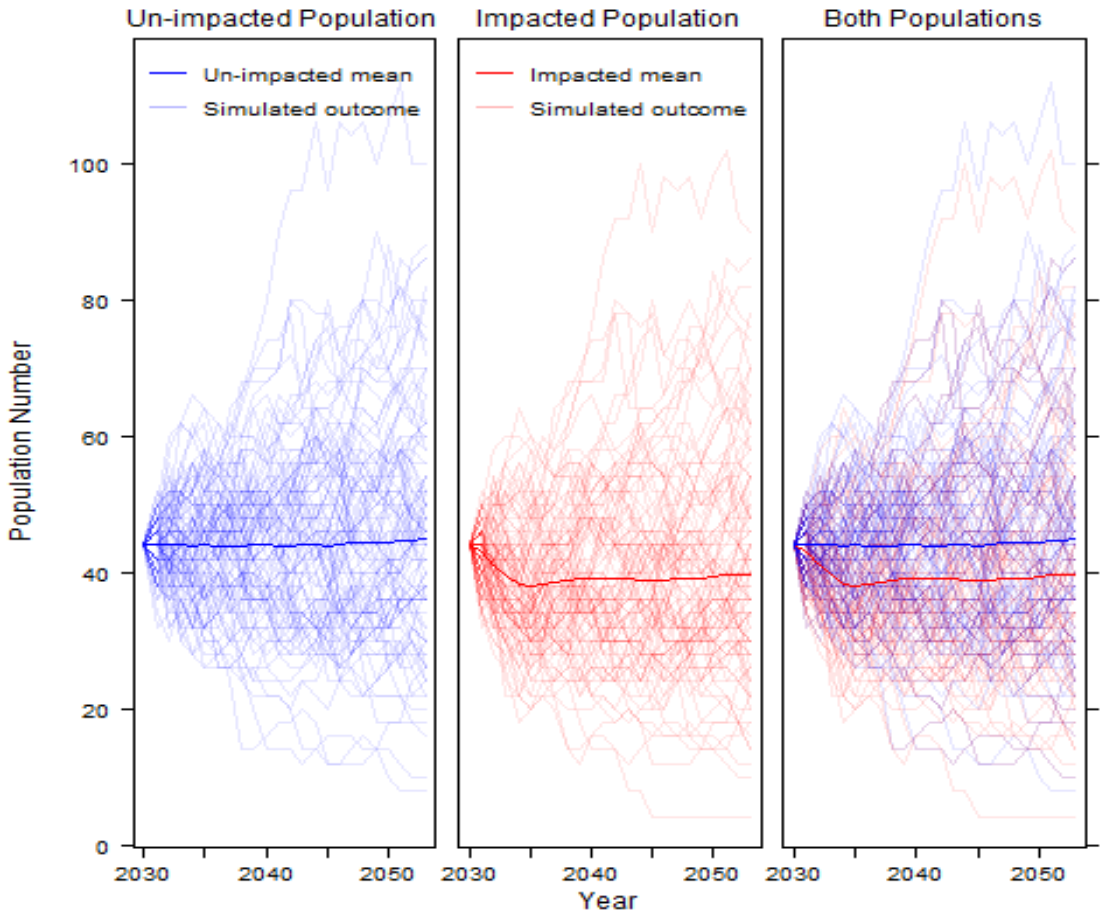


Plate 10.2 Simulated worst-case bottlenose dolphin (CWSH MU) population sizes for both the unimpacted and the impacted populations.

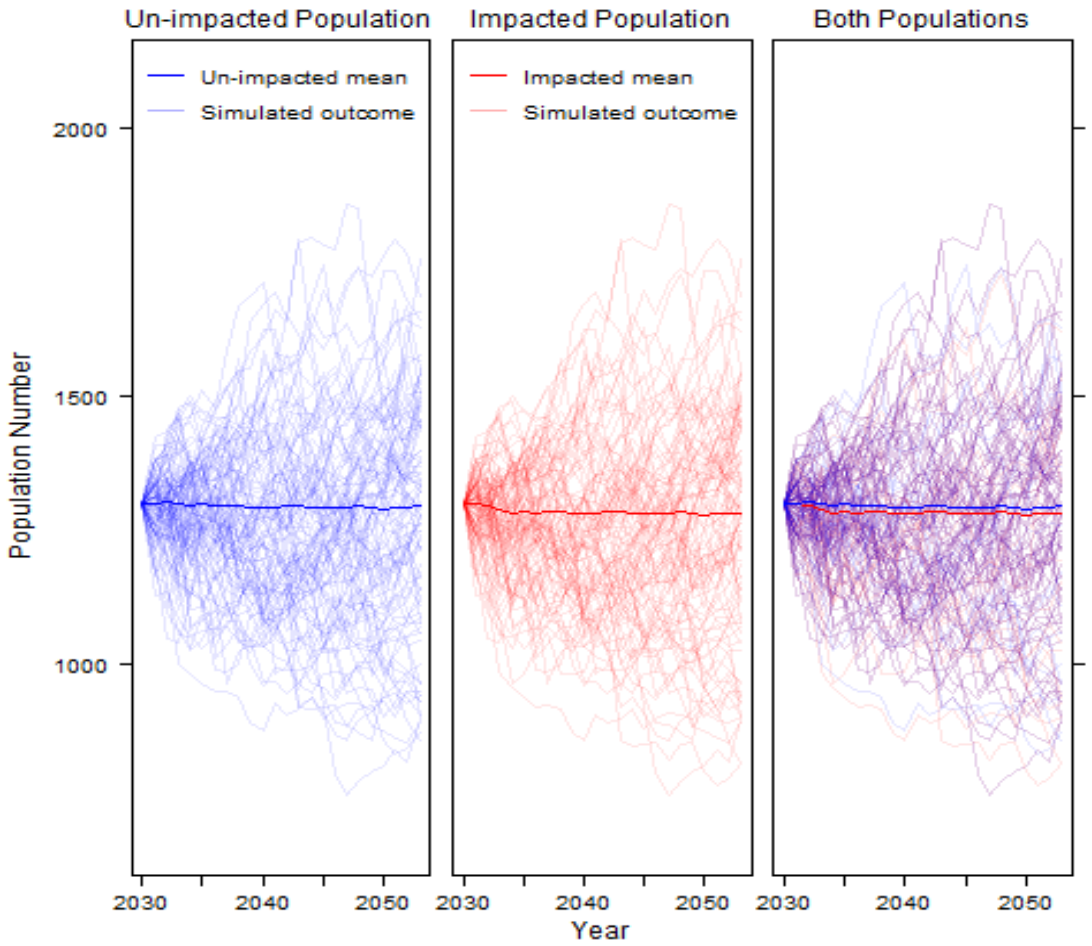


Plate 10.3 Simulated worst-case bottlenose dolphin (OW MU) population sizes for both the unimpacted and the impacted populations

10.12.1.6.3.1.3 Minke whale

209. The population modelling for minke whale is based on;

- A worst-case of potentially 264 minke whale being disturbed;
  - The potential number of minke whale that could be disturbed from a single monopile installation came from the assessment using EDRs (**Table 10.36**). The EDR approach was used as described above for harbour porpoise.
- PTS was not incorporated for minke whale due to the lack of expert elicitation or empirical data regarding PTS. However, Population modelling for minke whale incorporating PTS numbers from SEL_{cum} / $L_{E,p,t}$ is presented in **Appendix 10.4 iPCoD Modelling Technical Report** for information purposes as agreed with NatureScot.

210. **Plate 10.4** illustrates the mean unimpacted and impacted minke whale populations overlaid together. The numbers from the iPCoD are presented in **Appendix 10.4 iPCoD Modelling Technical Report** and indicates that by the end of 2033, the year that piling concludes, the median and mean ratio of impacted to unimpacted population size is projected to be 99.94% and 99.90%. Beyond 2035, the impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point.

211. As there is less than 1% difference between the unimpacted and impacted population over the first 6 years and the whole 25 year period, in both the median and the mean since piling started, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

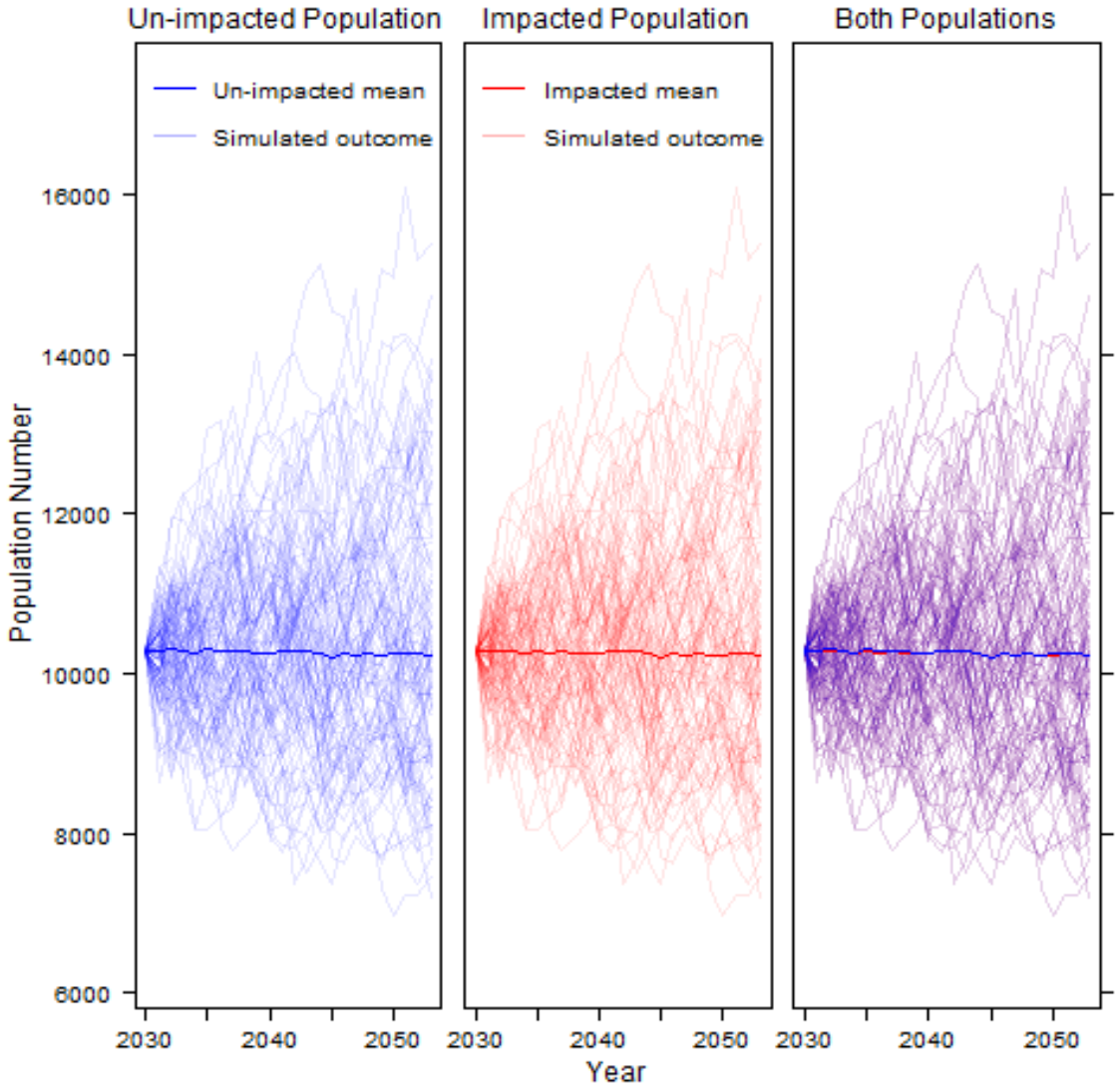


Plate 10.4 Simulated worst-case minke whale population sizes for both the unimpacted and the impacted populations

10.12.1.6.3.1.4 Grey seal

212. The population modelling for grey seal is based on;

- A worst-case of potentially 4,548 grey seal being disturbed;
  - The worst-case results for the potential number of grey seal that could be disturbed from one monopile installation came from the DRC assessment (**Table 10.35**).
- Zero individuals being at risk of PTS;
  - Based on the assessment of PTS (impact range and number of potential individuals at risk of PTS) (**Table 10.24**)).

213. Grey seal has been modelled for the West MU and the Wider MU.

214. **Plate 10.5** and **Plate 10.6** illustrates the mean unimpacted and impacted grey seal populations overlaid together. The numbers from the iPCoD are presented in **Appendix 10.4 iPCoD Modelling Technical Report** and indicate that by the end of 2033, the year that piling concludes, the median and mean ratio of impacted to unimpacted population size is projected to be 99.94 and 99.88% (WS MU) and 100% (Wider MU). The impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point.

215. As there is less than 1% difference between the unimpacted and impacted population over the first 6 years and the whole 25 year period, for both the median and the mean since the piling started, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

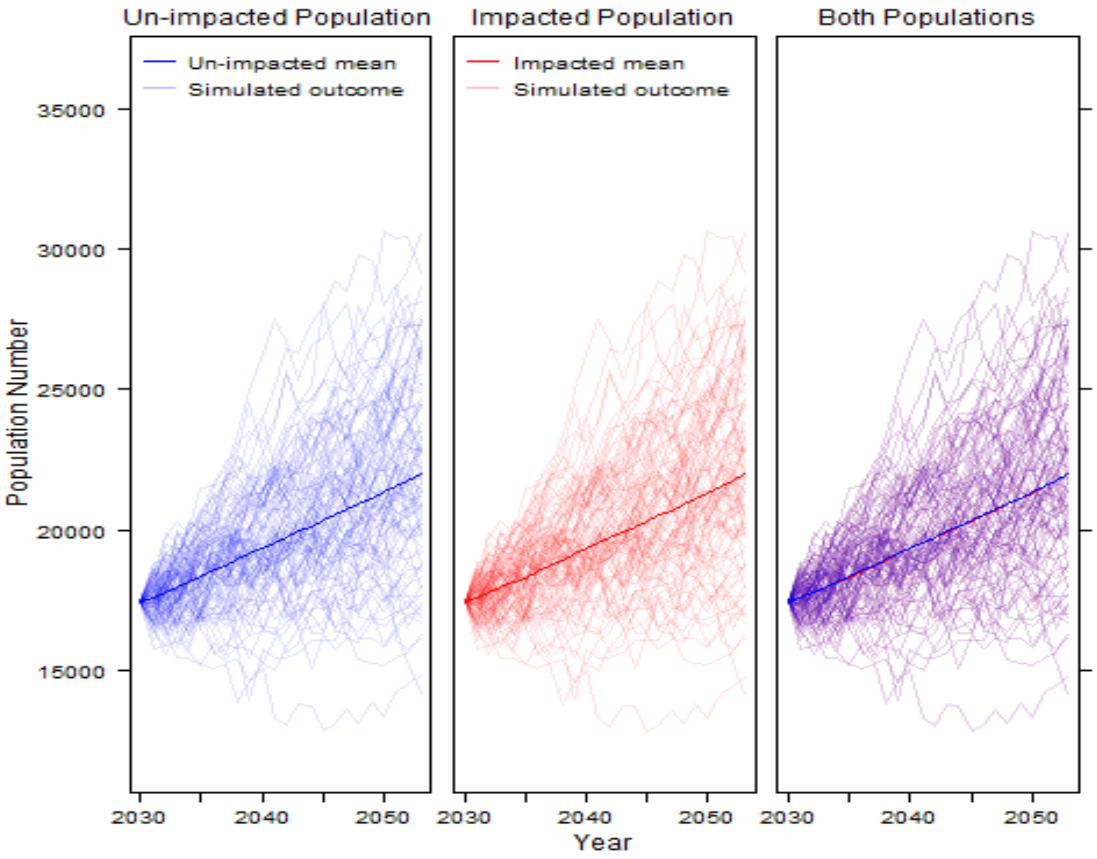


Plate 10.5 Simulated worst-case grey seal (WS MU) population sizes for both the unimpacted and the impacted populations

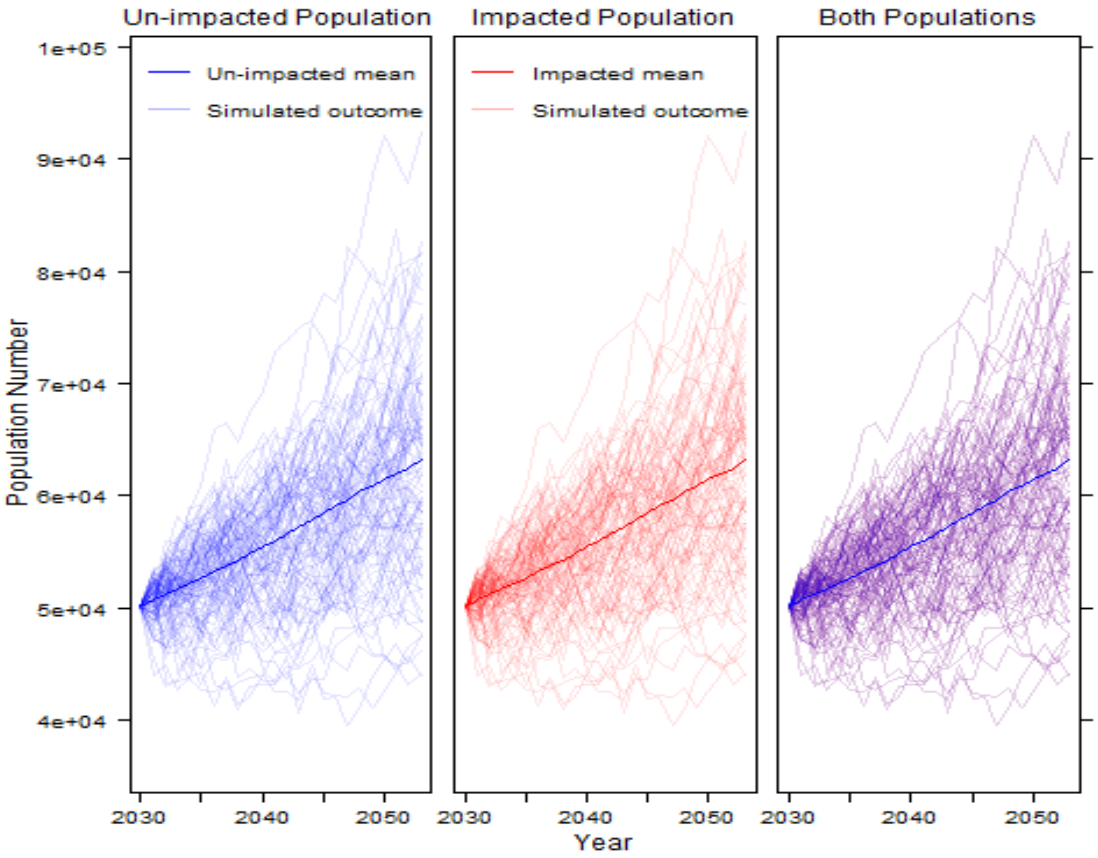


Plate 10.6 Simulated worst-case grey seal (wider MU) population sizes for both the unimpacted and the impacted populations

10.12.1.6.3.1.5 Harbour seal

- A worst-case of potentially 1,049 harbour seal being disturbed;
  - The worst-case results for the potential number of harbour seal that could be disturbed from one monopile installation came from the DRC assessment (**Table 10.35**).
- Up to one individual being at risk of PTS;
  - Based on the PTS (impact range and number of potential individuals at risk of PTS) (**Table 10.24**)).

216. Harbour seal has been modelled for the West MU and the Wider MU.

217. **Plate 10.7** and **Plate 10.8** illustrates the mean unimpacted and impacted harbour seal populations overlaid together. The numbers from the iPCoD are presented in **Appendix 10.4 iPCoD Modelling Technical Report** and indicate that by the end of 2033, the year that piling concludes, the median ratio of impacted to unimpacted population size is projected to be 100% (WS MU) and 100% (Wider MU). The impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point.

218. As there is less than 1% difference between the unimpacted and impacted population, in both the median and the mean since the piling started, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

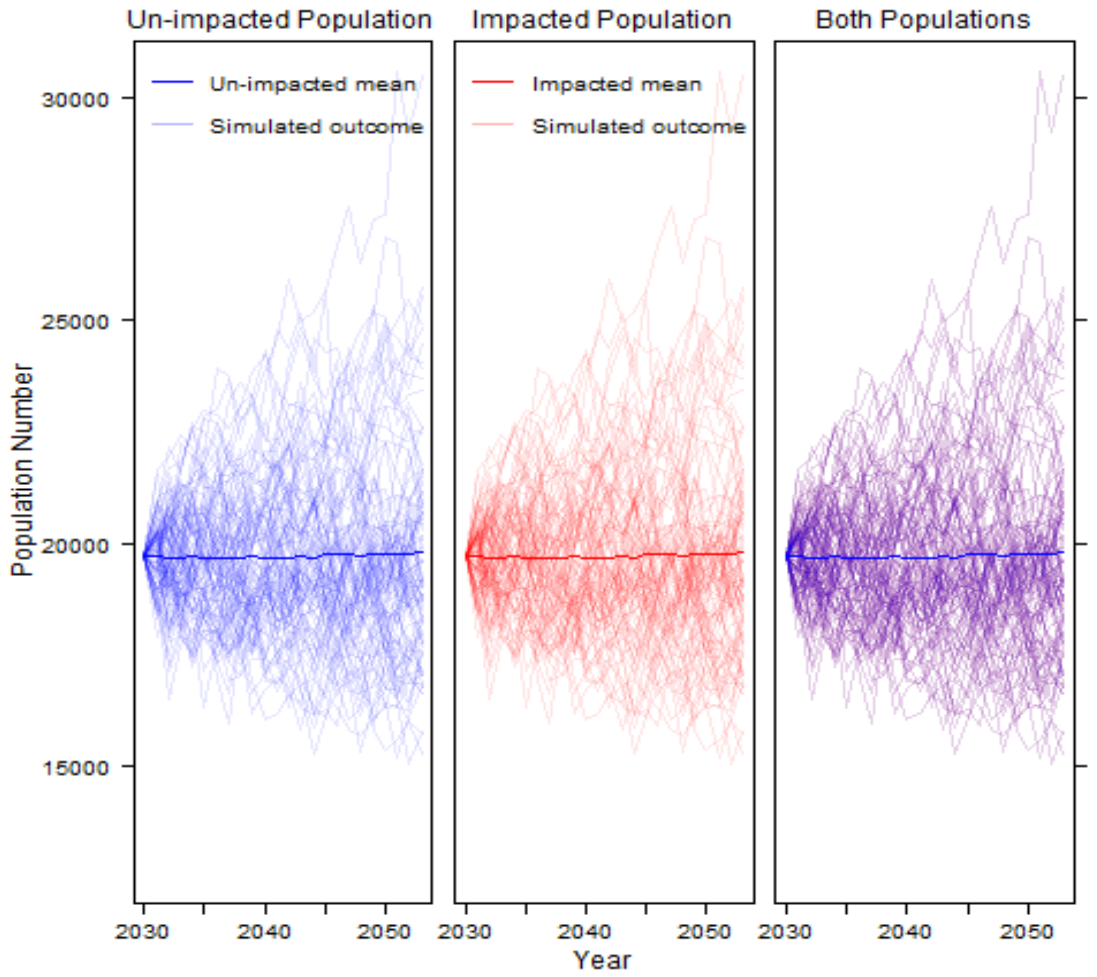


Plate 10.7 Simulated worst-case harbour seal (WS MU) population sizes for both the unimpacted and the impacted populations.

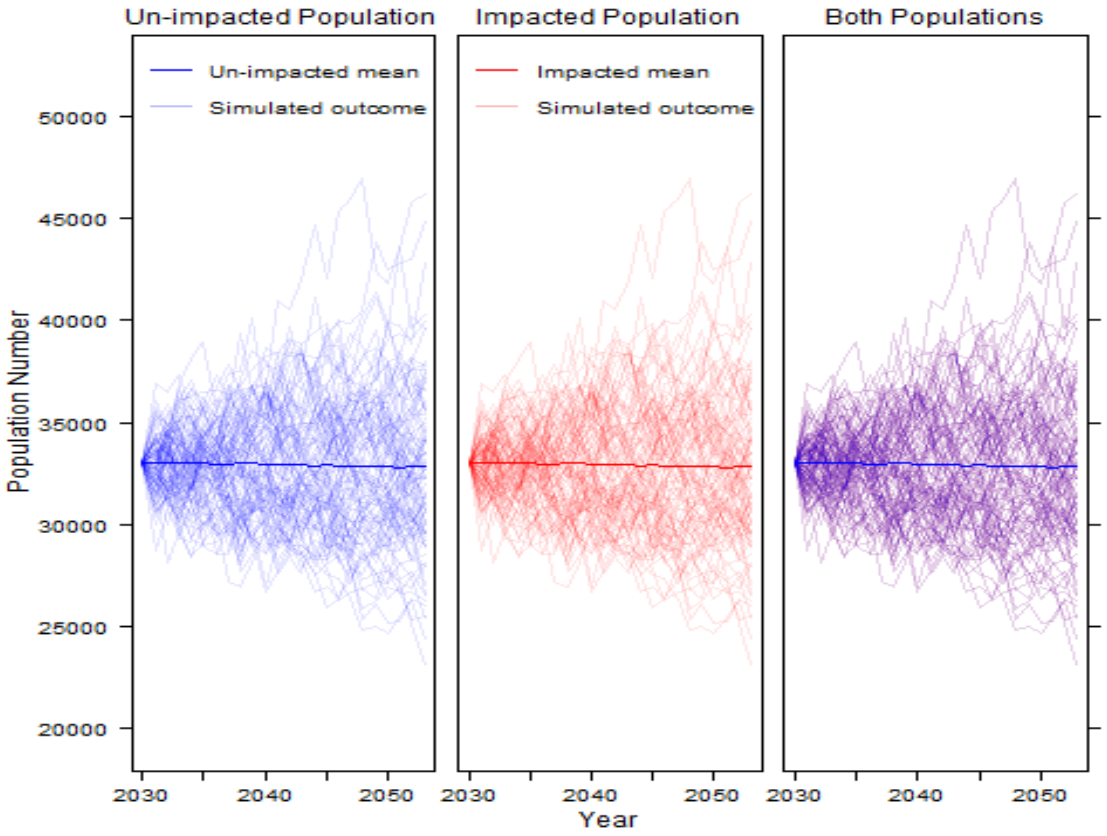


Plate 10.8 Simulated worst-case harbour seal (wider MU) population sizes for both the unimpacted and the impacted populations

10.12.1.6.3.1.6 Summary of population level consequences due to disturbance

219. All receptors have been classified as having **medium** sensitivity to disturbance from piling. For the installation of monopiles taking into account the sensitivity, the significance of effect from potential disturbance from piling was **moderate adverse** for the CWSH MU bottlenose dolphins population, which is significant in EIA terms. The significance of effect has been assessed as **negligible adverse**, which is **not significant** in EIA terms for harbour porpoise, bottlenose dolphins (OW MU), minke whale, grey seal and harbour seal.

10.12.1.6.3.2 Conclusion of Significance of Effect

220. There is no embedded mitigation specifically designed for the potential for disturbance from piling, however, while the embedded mitigation for PTS, as set out in **paragraph 155** above, would not mitigate for all disturbance effects, it would reduce the effect by ensuring marine mammals are deterred from the area prior to piling.

221. As different cetacean groups have distinct hearing ranges, sensitivities, and behavioural responses, a dose-response curve derived from harbour porpoises inherently reflects the unique auditory profile of that species. As a result, applying the Graham et al. (2017) curve to cetaceans with less sensitive or differently tuned hearing introduces a bias, creating a substantial risk of either overestimating or underestimating the true level of disturbance for those other species.

222. All receptors have been classified as having **medium** sensitivity to disturbance from piling (**Table 10.14**). Results from the DCR have resulted in high and medium magnitudes, however the results for the deterrent distance-based function for harbour porpoise resulted in a low magnitude

(while for the DRC this resulted in a high magnitude), indicating that the DRC approach is overly precautionary. Thompson et al. (2025) has shown that existing approaches to estimating disturbance to harbour porpoise from impact piling using the DRC assessment in UK waters are likely to be unrealistically conservative and that use of distance-based response functions may be more appropriate. This conclusion is in line with the EDR assessment, the distance-based function and results from the population modelling, which all show a negligible to low magnitude for harbour porpoise, compared to a high magnitude for DRC.

223. Based on the above, overall significances are concluded to be more realistic when based on the results of the EDR assessment for all species, which resulted in a negligible or low magnitude for all species except bottlenose dolphin (of the CWSH population), killer whale (of the WCC) and grey seal (of the WS MU). For all species (except those noted above), this results in a **negligible** to **minor adverse** significance overall, which is **not significant** in EIA terms.

224. For bottlenose dolphin (of the CWSH population) and killer whale (of the WCC), this is considered overly precautionary, primarily because of the very small population sizes involved; approximately 45 individuals for the CWSH bottlenose dolphin population and eight individuals for the west coast killer whale community. As a result, percentage-based calculations appear disproportionately large when applied to such limited reference populations. However, professional judgement is applied to provide a more ecologically realistic interpretation, recognising that the calculations are affected by an inflated scale effect, which has been clearly shown in the results from the iPCoD modelling for bottlenose dolphin.

225. Drawing on ecological expertise, the initial assessment of a moderate adverse effect for bottlenose dolphin, based on the iPCoD modelling, is considered overly precautionary. Furthermore, the assessment assumes that the entire MU would be present within the piling area, a scenario regarded as highly unlikely. In addition, and most importantly, the use of EDRs derived for harbour porpoises to assess impacts on other cetacean species is highly precautionary. Harbour porpoises are among the most sensitive species to high-frequency impulsive noise, such as that generated during piling, due to their specialised hearing range and behavioural thresholds. Delphinids and mysticetes have markedly different auditory sensitivities and are less vulnerable to these frequencies, as is shown by the results of the underwater noise modelling, which takes account of different species' group hearing abilities (e.g. TTS range for harbour porpoise is 2,400 m, while for delphinids is 50m (**Table 10.28**)). Therefore, applying harbour porpoise based EDRs likely overestimates disturbance ranges and potential impacts for these species. This approach ensures a conservative assessment but does not reflect a species-specific response.

226. Therefore, the significance of effect for bottlenose dolphin and killer whale has been assessed based on the wider population, which is low for bottlenose dolphin and negligible for killer whale, resulting in a **negligible** to **minor adverse** effect overall, which is **not significant** in EIA terms.

227. For grey seal the significance of effect from the DCR resulted in a major adverse effect for the WS MU. The Whyte et al. (2020) DCR is based solely on harbour-seal telemetry data. Grey and harbour seals differ in behavioural ecology, indicating distinct behavioural responses to disturbance (Carter et al., 2022). The Whyte et al. (2020) dataset also shows high uncertainty, with anomalous values and wide confidence intervals, making its use for grey seals highly precautionary. Therefore, applying a harbour-seal DCR to grey seals is not biologically representative and likely overestimates disturbance. Additionally, Thompson et al. (2025) demonstrated that the use of DRC assessments is likely to be overly precautionary, and that deterrent distance-based response functions provide a more realistic representation of disturbance. This approach is also considered applicable to pinnipeds.

228. For grey seal, the EDR approach resulted in a medium magnitude for the WS MU, however, the iPCoD results in a negligible adverse effect. The iPCoD model is an appropriate tool for determining the significance of disturbance effects on seals because it was specifically developed to assess population-level impacts arising from piling noise, and explicitly includes both seal species within its framework. It is widely used in UK offshore wind EIAs to evaluate how short-term behavioural disturbance may influence long-term population trajectories, providing a transparent and regulator-endorsed method for significance assessment. For that reason, the concluding significance of effect for grey seal is considered to be **minor adverse**, which is **not significant** in EIA terms.

229. For all other receptors, the significance of effect is assessed as **negligible adverse**, which is **not significant** in EIA terms (**Table 10.40**).

Table 10.40 Significance of effect for impact 4: Behavioural impacts from underwater noise during piling

Receptor	Sensitivity	Magnitude[9]	Significance of Effect	Additional Mitigation	Residual Effect
Harbour porpoise & common dolphin	Medium	Low	Minor adverse	N/A	Not significant
Bottlenose dolphin		Low (CWSH MU & OW)[10]	Negligible adverse (CWSH MU & OW)	N/A	Not significant (CWSH MU & OW)
Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
Killer whale		Negligible (WCC & NA)[10]	negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
Minke whale		Low	Minor adverse	N/A	Not significant
Grey seal & harbour seal*		Negligible[11] (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
**Magnitudes and significance of effect in brackets are for the wider reference populations used in the assessment*					

10.12.1.6.3.2.1 Disturbance during ADD activation

230. For the potential disturbance associated with ADD activation, the worst-case magnitude has been taken from the assessments in **Section 10.12.1.6.2**. The sensitivity of the bottlenose dolphin MU (CWSH MU) has been assessed as **low**, while the magnitude of impact is **high**, which is significant in EIA terms. However, as outlined in **Section 10.12.1.6.3.2** above, this is deemed over precautionary, due to percentage-based calculations which appear disproportionately large when applied to such a limited reference population. Professional judgement is used to interpret results in a more ecologically realistic way by looking beyond numerical outputs, recognising when calculations

[9]based on EDR approach; see **paragraphs 222** & **223**
[10]see paragraphs **224** & **225**
[11]see paragraphs **227** & **228**

create an inflated scale effects, and applying specialised knowledge of species ecology, population dynamics, and impact pathways. Based on this view, it is concluded that the true level of risk is better reflected by the wider population estimate, and therefore a **negligible adverse** effect is considered appropriate (based on the OW MU magnitude of low). The magnitude for other delphinids is assessed as **low** or **negligible**, and therefore the significance of effect has been assessed as **negligible** or **minor adverse**, which is **not significant** in EIA terms (**Table 10.41**).

231. The magnitude has been assessed as **low** for the WCC population of killer whales and grey seal (WS MU). With a low sensitivity, this results in a **negligible adverse** effect, **not significant** in EIA terms (**Table 10.41**).

232. For all other receptors, the magnitude has been assessed as **negligible**, and with a low or medium sensitivity (refer to **Table 10.14** or **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**. for receptors sensitivities), the significance of effect is assessed as **negligible adverse**, **not significant** in EIA terms (**Table 10.41**).

Table 10.41 Significance of effect for impact 4: Behavioural impacts from underwater noise during piling (ADD activation)

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Harbour porpoise, minke whale, fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Negligible adverse
Bottlenose dolphin	Low	Low (CWSH MU & OW MU; see **paragraph 230**)	Negligible adverse (CWSH MU & OW MU)	N/A	Minor adverse[10] (CWSH MU & OW MU)
Common dolphin		Low	Negligible adverse	N/A	Negligible adverse
Atlantic white-sided dolphin, white-beaked dolphin & Risso' dolphin		Negligible	Negligible adverse	N/A	Negligible adverse
Killer whale		Low (WCC) Negligible (NA)	Minor adverse (WCC) Negligible adverse (NA)	N/A	Minor adverse (WCC) Negligible adverse (NA)
Long-finned pilot whale		Negligible	Negligible adverse	N/A	Negligible adverse
Grey seal*	Low	Low (negligible)	Minor adverse (negligible adverse)	N/A	Minor adverse (negligible adverse)
Harbour seal*	Low	Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Negligible adverse (negligible adverse)
Leatherback turtle	Low	Negligible	Negligible adverse	N/A	Negligible adverse
**Magnitudes and significance of effect in brackets are for the wider reference populations used in the assessment*					

10.12.1.6.3.3 Designated Sites

233. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by piling within the WDA. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment within this EIAR. As no significant effects on the WS MU are predicted as a result of underwater noise from piling (**Table 10.36**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

234. For minke whale, a single designated site may be affected by piling within the WDA: the Sea of the Hebrides NCMPA. Based on the NCMPA-specific minke whale density presented in the **Report to Inform the Marine Protected Area Assessment**, up to 45 individuals (<2% of the NCMPA population) may be subject to disturbance, as assessed using the EDR and Level B harassment approach.

235. For pinnipeds, several designated sites may be affected by piling within the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider populations are predicted, no significant effects are anticipated for grey or harbour seal at any of these designated sites (**Table 10.40**).

10.12.1.7 Impact 5: Auditory injury and behavioural impacts from non-piling activities

236. Potential sources of underwater noise during non-piling construction activities include drilling, rock placement, trenching, dredging, and cable laying. OSPAR (2009) reports no strong evidence that noise from subsea cable installation poses a significant threat to marine mammals. However, because dredging generally produces higher noise levels, marine mammal behavioural responses to dredging are expected to be similar to those observed during cable installation.

237. Dredging and cable installation can generate underwater noise at levels, frequencies, and durations capable of disturbing marine mammals. Noise output from dredging varies with factors such as the type of dredger, installation method, and environmental conditions—including sediment composition, water depth, salinity, thermoclines, and background noise (Jones and Marten, 2016; Robinson et al., 2011; Theobald et al., 2011). These factors also influence sound propagation underwater. Reviews of underwater noise from dredging and cable installation (e.g., Thomsen et al., 2006; Theobald et al., 2011; Todd et al., 2014) indicate that the sound levels marine mammals typically experience remain below thresholds for permanent auditory injury (PTS) defined by Southall et al. (2019). Accordingly, the risk of auditory injury from these activities is considered very low.

238. Temporary hearing loss (TTS) thresholds could potentially be exceeded during dredging, but only if receptors remain within approximately 1 km of the dredging operations for extended periods, an event regarded as highly unlikely (Todd et al., 2014).

10.12.1.7.1 Underwater Noise Modelling

239. Underwater noise modelling was undertaken to assess the likelihood of PTS and TTS in marine mammals from non-piling construction activities. Full details are provided in **Appendix 10.1 Underwater Noise Modelling Report**.

240. Modelled impact ranges for PTS are below the threshold for all fleeing marine mammal species, (see Section 5.1 in **Appendix 10.1 Underwater Noise Modelling Report**). The modelling also applied a precautionary assumption that animals remain stationary near the noise source once activity begins, despite this being unlikely in reality. Under this conservative scenario, PTS is still not expected except

potentially during suction dredging and rock placement for stationary marine mammals (**Table 10.42**).

241. As a precaution, PTS is therefore assessed for harbour porpoise using the worst-case impact range of 1 km. TTS is assessed for all receptors using the worst-case impact range associated with rock placement.

10.12.1.7.2 Sensitivity

242. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.7.3 Magnitude of Impact

10.12.1.7.3.1 Auditory Injury (PTS/TTS)

10.12.1.7.3.1.1 Construction

243. PTS is unlikely to occur from construction activities such as dredging, cable laying and drilling, as receptors would need to be in close proximity to the noise source. This is considered improbable because animals are expected to pass through or move away from the area. For rock placement, predicted PTS impact ranges for all marine mammals are less than 50 m when assuming fleeing behaviour (based on the swim speeds described in **Section 10.12.1.6.2**). The only exception is for harbour porpoise for which the model predicts a PTS range of 1 km under an extremely precautionary scenario where the animal is assumed to remain stationary for 24 hours (**Table 10.42**). For PTS to occur in harbour porpoise or any mysticetes, an individual would therefore need to stay within the impact zone for an extended 24-hour period, which is highly unlikely. As such, the assessment of PTS in harbour porpoise during rock placement represents a highly precautionary approach.

244. PTS in all other stationary receptors for all non-piling construction activities is predicted to be less than 50 m, with exception of 60 m from dredging activities for mysticetes (**Table 10.42**). Due to the low impact ranges, PTS has only been assessed for harbour porpoise and mysticetes and has been scoped out for all other receptors as no LSEs are anticipated.

245. The largest TTS ranges for all marine mammals arise from rock placement activities, with greater distances predicted for stationary receptors (**Table 10.42**). For TTS to occur, an animal would need to remain within the impact zone for approximately 24 hours to experience prolonged underwater noise exposure. This is considered unlikely, as marine mammals are expected to pass through the area or move away once activity begins. As such, assessing TTS for stationary marine mammals during rock placement represents a highly precautionary approach (**Table 10.43**). The magnitude for TTS from underwater noise from a single rock placement activity is assessed as **negligible** for all marine mammals (**Table 10.43**).

246. The magnitude of impact for TTS from underwater noise from multiple non-piling activities using the predicted TTS ranges for one rock placement, suction dredging, cable laying and trenching activity occurring at the same time within the WDA (not taking into account any spatial overlap) is assessed as **negligible** for all receptors (**Table 10.43**).

10.12.1.7.3.1.2 O&M

247. O&M activities are considered long term, so the magnitude will be assessed on long term effects rather than temporary effects (see **Table 10.11**). Rock placement or cable re-burial may occur during the O&M phase, though the exact scope is currently uncertain. Any associated effects on marine mammals would be highly intermittent, and within discrete areas of the WDA although could occur

at any point over the anticipated 35-year operational life of the Project and so is considered long-term. The magnitude of impact for TTS from underwater noise from rock placement activities is assessed as **negligible** for all receptors (**Table 10.44**).

248. For multiple non-piling activities occurring in the WDA (as described for construction in **Section 10.12.1.7.3.2**) during the O&M phase, the magnitude is based on long-term effects and is assessed as **low** for harbour porpoise, bottlenose dolphin (CWSH MU), minke whale, the WCC killer whales, and grey seal (WS MU). However, this assessment is highly precautionary as it does not consider any spatial overlap within the WDA. It is also very unlikely for any receptor to remain stationary next to a noisy source for approximately 24-hours. For all other receptors the magnitude is assessed as **negligible** (**Table 10.44**).

10.12.1.7.3.1.3 Decommissioning

249. Underwater noise generating activities may occur during the decommissioning phase, although the exact scope is currently uncertain. Any associated effects on marine mammals are expected to be similar to, or less than, those evaluated during the construction phase (see **Section 10.12.1.7.3.2**).

*Table 10.42 Predicted impact ranges for TTS from 24- hour cumulative exposure (SEL_{cum} / $L_{E,p,t}$) during non-piling activities during construction for both a fleeing and a stationary receptor (impact ranges used for the assessment are in **bold**)*

Non piling noisy activity	Harbour porpoise (VHF)		Delphinids (HF) & Leatherback turtle		Mysticetes (LF)		Pinnipeds (PCW)	
	PTS	TTS	PTS	TTS	PTS	TTS	PTS	TTS
	SEL_{cum} / $L_{E,p,t}$ Weighted (173 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (153 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (198 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (178 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (199 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (179 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (201 dB re 1 µPa2s) Non-impulsive	SEL_{cum} / $L_{E,p,t}$ Weighted (181 dB re 1 µPa2s) Non-impulsive
Impact range (m) Fleeing receptor								
Cable laying	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Dredging (backhoe)	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Dredging (suction)	< 50	250	< 50	< 50	< 50	< 50	< 50	< 50
Drilling	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Rock placement	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Trenching	< 50	520	< 50	< 50	< 50	< 50	< 50	< 50
Impact range (m) Stationary receptor								
Cable laying	< 50	1,300	< 50	< 50	< 50	970	< 50	90
Dredging (backhoe)	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Dredging (suction)	560	4,200	< 50	380	**60**	630	< 50	420
Drilling	< 50	200	< 50	< 50	< 50	160	< 50	< 50
Rock placement	**1,000**	**6,200**	< 50	**490**	< 50	**2,000**	< 50	560
Trenching	60	1,800	< 50	< 50	< 50	820	< 50	110

Table 10.43 Maximum number of individuals (and % of reference population) that could be exposed to auditory injury if stationary as a result of underwater noise associated with non-piling construction activities at the WDA (NE: non exceedance and N/A: not applicable)

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
	PTS		**TTS from 1 activity (*Rock placement*)**		**TTS from 4 activities occurring at the same time (*Dredging (suction), rock placement, cable laying and trenching*)**	
Harbour porpoise	2 (0.005% WS MU)	Negligible	51 (0.2% NS MU)	Negligible	55 (0.23% NS MU)	Negligible
Bottlenose dolphin	NE	NE	<1 (0.07% CWSH MU & 0.002% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.1% CWSH MU & 0.01% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin	NE	NE	<1 (0.001% CGNS MU)	Negligible	1 (0.004% CGNS MU)	Negligible
Atlantic white-sided dolphin	NE	NE	<1 (0.0001% CGNS MU)	Negligible	<1 (0.0002% CGNS MU)	Negligible
White-beaked dolphin	NE	NE	<1 (0.0006% CGNS MU)	Negligible	1 (0.0009% CGNS MU)	Negligible
Risso' dolphin	NE	NE	<1 (0.00009% CGNS MU)	Negligible	<1 (0.0001% CGNS MU)	Negligible
Killer whale	NE	NE	<1 (0.009% WCC & 0.000005% NA)	Negligible (WCC & NA)	<1 (0.01% WCC & 0.000008% NA)	Negligible (WCC & NA)
Long-finned pilot whale	NE	NE	<1 (0.00002% CGNS MU)	Negligible	<1 (0.00003% CGNS MU)	Negligible
Minke whale	<1 (0.00002 % CGNS MU)	Negligible	3 (0.03% CGNS MU)	Negligible	4 (0.04% CGNS MU)	Negligible
Fin whale	<1 (0.000001 % N.A MU)	Negligible	<1 (0.0008% NA)	Negligible	<1 (0.001% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible	N/A	Negligible
Grey seal*	NE	Negligible	1 (0.005% WS MU & 0.002% Wider MU)	Negligible (negligible)	2 (0.01% WS MU & 0.002% Wider MU)	Negligible (negligible)

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)
	PTS		**TTS from 1 activity (*Rock placement*)**		**TTS from 4 activities occurring at the same time (*Dredging (suction), rock placement, cable laying and trenching*)**	
Harbour seal*	NE	NE	<1 (0.0004% WS MU & 0.0002% Wider MU)	Negligible (negligible)	<1 (0.0006% WS MU & 0.0003% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	N/A	N/A	Negligible	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*						

Table 10.44 Maximum number of individuals (and % of reference population) that could be exposed to auditory injury as a result of underwater noise associated with O&M activities at the WDA (NE: non exceedance and N/A: not applicable)

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)
	PTS		**TTS from 1 activity**		**TTS from four activities occurring at the same time**	
Harbour porpoise	2 (0.005% WS MU)	Negligible	51 (0.2% NS MU)	Negligible	55 (0.23% NS MU)	Low
Bottlenose dolphin	NE	NE	<1 (0.07% CWSH MU & 0.002% OW MU)	Negligible (CWSH MU & OW MU)	<1 (0.1% CWSH MU & 0.003% OW MU)	Low (CWSH MU & OW MU)
Common dolphin	NE	NE	<1 (0.001% CGNS MU)	Negligible	1 (0.001% CGNS MU)	Negligible
Atlantic white-sided dolphin	NE	NE	<1 (0.0001% CGNS MU)	Negligible	<1 (0.0002% CGNS MU)	Negligible
White-beaked dolphin	NE	NE	<1 (0.0005% CGNS MU)	Negligible	<1 (0.001% CGNS MU)	Negligible
Risso' dolphin	NE	NE	<1 (0.00008% CGNS MU)	Negligible	<1 (0.0001% CGNS MU)	Negligible

Species	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (permanent)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)
	PTS		**TTS from 1 activity**		**TTS from four activities occurring at the same time**	
Killer whale	NE	NE	<1 (0.009% WCC & 0.000005% NA)	Negligible (WCC & NA)	<1 (0.01% WCC & 0.000008% NA)	Low (WCC & NA)
Long-finned pilot whale	NE	NE	<1 (0.00002% CGNS MU)	Negligible	<1 (0.00003% CGNS MU)	Negligible
Minke whale	<1 (0.00002 % CGNS MU)	Negligible	3 (0.03% CGNS MU)	Negligible	4 (0.03% CGNS MU)	Low
Fin whale	<1 (0.000001 % N.A MU)	Negligible	<1 (0.0008% NA)	Negligible	<1 (0.001% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible	N/A	Negligible
Grey seal*	NE	NE	1 (0.005% WS MU & 0.001% Wider MU)	Negligible (negligible)	2(0.01% WS MU & 0.004% Wider MU)	Low (negligible)
Harbour seal*	NE	NE	<1 (0.0004% WS MU & 0.0002% Wider MU)	Negligible (negligible)	<1 (0.0006% WS MU & 0.0003% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	NE	N/A	Negligible	N/A	Negligible
**Magnitudes in brackets are for the wider reference populations used in the assessment*						

10.12.1.7.3.2 Disturbance

10.12.1.7.3.2.1 Construction

250. Underwater noise generated during cable installation, dredging activities, rock placement and trenching may lead to disturbance or changes in behaviour among marine mammals (Pirotta et al., 2014; Todd et al., 2014; Southall et al., 2007). Studies conducted during the construction of the Beatrice and Moray East offshore windfarms in Scotland (Benhemma-Le Gall et al. 2021) found that the probability of harbour porpoise presence increased with distance from construction vessels and activities and decreased with higher vessel presence and elevated background noise levels. During the WTG installation phase at Beatrice, a marked reduction in harbour porpoise presence was detected even in the absence of piling. Multiple construction activities; such as jacket installation, WTG installation and cable installation all occurred concurrently, resulting in high levels of vessel traffic across the site. A reduction in porpoise occurrence was observed up to 4 km from construction related vessels (Plate 10.6; Benhemma-Le Gall et al. 2021). When construction vessels were 2 km from Cetacean Porpoise Detectors, harbour porpoise activity decreased by up to 35.2%. At 3 km, activity decreased by up to 24%, while at 4 km, activity increased by 7.2%. Outside piling periods, the study also reported a 17% reduction in harbour porpoise presence associated with sound pressure levels (SPLs) of 57 dB above ambient noise. It was not possible to determine which specific construction activities were responsible for these effects due to the limited detail available on vessel operations (Benhemma-Le Gall et al. 2021).

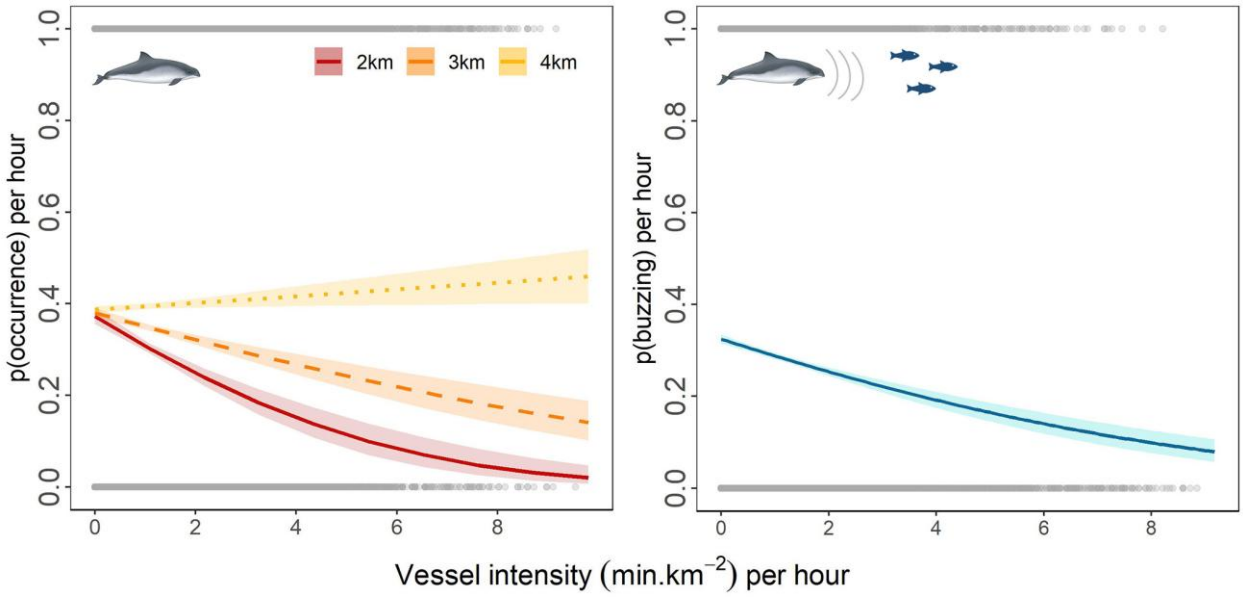


Plate 10.9 [Left] The Probability Of Harbour Porpoise Presence in Relation to Vessel Activity (Red = mean vessel distance of 2 km, Orange = mean vessel distance of 3 km, Yellow = mean vessel distance of 4 km, and [Right] The Probability of Buzzing Activity Per Hour in Relation to Vessel Activity (Benhemma-Le Gall et al..2021)

251. Although the study did not identify which specific construction activities were responsible for the disturbance, the reduction in harbour porpoise presence occurred when multiple construction vessels were operating on site (Benhemma-Le Gall et al. 2021). Consequently, the reported 4 km decrease in harbour porpoise occurrence has been adopted in this assessment as a potential disturbance

range for non-piling construction activities. If the behavioural response is displacement, receptors are expected to return once activities cease; therefore, any effects from underwater noise generated by non-piling construction activities are anticipated to be localised and temporary. As a result, significant disturbance to marine mammals or leatherback turtle is unlikely. Given that harbour porpoise are the most sensitive marine mammal species, this 4 km disturbance range has been applied to all receptors in the absence of alternative data making this a precautionary approach for all receptors.

252. Because the number of simultaneous non-piling activities within the WDA is unknown, the assessment applies the same approach used for vessel activity, incorporating a 4 km buffer around the WDA to create an impact area of 851.8 km² (see **Section 10.12.1.8.2.3**).

253. The number of receptors that could be exposed to disturbance from non-piling activities during the construction phase is presented in **Table 10.49** in **Section 10.12.1.8.2.3**.

254. The magnitude for disturbance from a single non-piling activity in the WDA is assessed as **medium** for bottlenose dolphin (CWSH MU), **low** for harbour porpoise and **negligible** for all other receptors.

255. For multiple non-piling activities the magnitude is assessed as **high** for bottlenose dolphin (CWSH MU) and killer whale (WCC), **low** for harbour porpoise, bottlenose dolphin (OW MU) common dolphin, minke whale and grey seal (both WS MU and wider MU). For all other receptors, the magnitude of impact is assessed as **negligible** (**Table 10.49** in **Section 10.12.1.8.2.3**).

256. Any disturbance caused by underwater noise during construction is expected to be short-term, intermittent, and confined to specific locations and timeframes within the anticipated maximum offshore construction period of five years.

10.12.1.7.3.2.2 O&M

257. Activities such as, rock placement, dredging or cable re-burial may occur during the O&M phase, (see **Chapter 3 Project Description** and **Table 10.5**). Any associated effects on receptors would be highly intermittent, and within discrete areas of the WDA although could occur at any point over the anticipated 35-year operational life of the Project and so are considered long-term rather than temporary.

258. To assess for potential exposure to disturbance from non-piling activities in the WDA, the same approach has been taken as described for construction but assessed on the long-term criteria due to the repeated exposure during the O&M phase. The magnitude for disturbance from a single non-piling activity for bottlenose dolphin (CWSH MU) is assessed as **high** in line with the assessment for vessel noise in **Section 10.12.1.8.2.3 - Table 10.51**). The magnitude for disturbance from a single non-piling activity is assessed as **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, white beaked dolphin, killer whale (WCC) minke whale, grey seal and harbour seal. The magnitude is **negligible** for all other receptors.

259. The maximum number of vessels operating in the WDA during the O&M phase could be 13. Therefore, a precautionary assumption is for a maximum of 13 non-piling activities to occur in the WDA simultaneously, which is over precautionary as it is highly unlikely for all individual vessels to be carrying out separate O&M activities and for these activities to occur at the same time. The magnitude for disturbance from non-piling activities in the WDA is assessed as **high** for bottlenose dolphin (CWSH MU) and killer whale (WCC) (**Table 10.51**). The magnitude is assessed as **medium** for harbour porpoise, minke whale and grey seal (both MUs). The magnitude is assessed as **low** for all other receptors in line with the assessment presented for vessel noise in **Table 10.51**.

10.12.1.7.3.2.3 Decommissioning

260. The magnitude of impact is expected to be the same, if not less, than construction..

10.12.1.7.4 Significance of Effect

10.12.1.7.4.1 PTS (Harbour Porpoise and Mysticetes Only) and TTS (All Receptors)

261. The significance of effect for auditory injury from non-piling activities during the construction phase is presented in **Table 10.45**. The sensitivity is **high** for all receptors for PTS (**Table 10.14**). Underwater noise modelling showed that the predicted PTS for individual non-piling activities was less than 50 m for delphinids, pinnipeds and leatherback turtle. This indicates that PTS is not expected to occur, as the hearing threshold is non-exceedance, therefore an assessment of PTS was only carried out for harbour porpoise and mysticetes. The magnitude of impact is **negligible**, resulting in a **minor adverse effect**, which is **not significant** in EIA terms. As harbour porpoise represents the most sensitive receptor for PTS, a minor adverse significance outcome is therefore appropriate for all other receptors.

262. For all receptors, the sensitivity is **medium** for TTS, and the magnitude of impact is **negligible** for a stationary receptor, resulting in a **negligible adverse** effect for TTS for all receptors (including harbour porpoise) which is **not significant** in EIA terms.

263. The significance of effect for TTS from multiple non-piling activities in all receptors (based on the stationary criteria) has been based on four non-piling activities in the WDA simultaneously. Four simultaneous activities were adopted as the realistic worst-case scenario, as the likelihood of a greater number occurring concurrently is low and any resultant overlap in impact ranges would remain minimal throughout the WDA (**Table 10.42**). Therefore, the assessment is considered to be suitably precautionary. For multiple non-piling activities occurring at the same time in the construction phase, the magnitude is assessed as **negligible** for all receptors, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

264. The O&M phase assessment considers long term effects rather than temporary (see **Section 10.10.1.3**). This is because the O&M phase spans the full operational lifetime of the Project, meaning that even low-intensity activities can give rise to more substantial effects when considered over many years. This contrasts with the construction phase, where high-intensity sound sources such as piling are short in duration and confined to a limited period. Routine vessel activity, maintenance operations, and recurrent disturbance events occur intermittently but persistently throughout the O&M phase, resulting in repeated exposure of receptors over extended timescales. Consequently, this assessment focuses on long-term, recurring effects rather than distinguishing between one-off permanent or temporary impacts, and the O&M phase is therefore considered to contribute a greater proportion of the overall disturbance pressure.

265. For multiple non-piling activities to occur in the O&M phase based on the stationary receptor criteria, the magnitude is assessed as **low** for harbour porpoise, bottlenose dolphin (CWSH MU), killer whale (WCC), minke whale and grey seal (WS MU) resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect; which is **not significant** in EIA terms (**Table 10.45**).

10.12.1.7.4.2 Disturbance

266. The effect significance for disturbance from non-piling activities is presented in **Table 10.45** and is the same as described for impacts from underwater noise from vessels in **Section 10.12.1.8.3.**

During the O&M phase, the magnitude of impact for disturbance is presented in **Table 10.45** and is the same as described for impacts from underwater noise from vessels in **Section 10.12.1.8.3**

10.12.1.7.4.3 Designated Sites

267. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by non-piling activities within the WDA during all phases of the Project. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment within this EIAR. As no significant effects on the WS MU are predicted as a result of underwater noise from non-piling activities (**Table 10.45**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

268. For minke whale, a single designated site may be affected by non-piling activities within the WDA: the Sea of the Hebrides NCMPA. Based on the NCMPA-specific minke whale density presented in the **Report to Inform the Marine Protected Area Assessment**, up to 30 individuals (1.22% of the NCMPA population) may be subject to disturbance from multiple non-piling activities. On this basis, no significant effects on the NCMPA are predicted due to non-piling activities.

269. For pinnipeds, several designated sites may be affected by non-piling activities within the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites (**Table 10.45**).

Table 10.45 Significance of effect from the potential for auditory injury due to non-piling activities within the WDA

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Construction and Decommissioning						
PTS	All marine mammals and marine turtles	High	Negligible	Minor adverse	N/A	Not significant
TTS	Harbour porpoise, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
Disturbance	Harbour porpoise, common dolphin, fin whale & humpback whale	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin		High (CWSH MU) Low (OW MU)	Minor adverse[12] (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale & minke whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		High (WCC) Negligible (NA)	Minor adverse[12] (WCC)	N/A	Not significant (WCC & NA)

[12]Due to information presented in **Paragraph 308** for Impact 6, assigning the significance effect as moderate adverse is considered to be over precautionary.

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
				(Negligible adverse (NA)		
	Grey seal*		Low (low)	Negligible adverse (negligible adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
O&M						
Disturbance	Harbour porpoise, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin & minke whale	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin		High (CWSH MU) Medium (OW MU)	Minor adverse[12] (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Risso' dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		High (NA) Negligible (NA)	Minor adverse[12] (NA) Negligible adverse (NA)	N/A	Not significant (WCC & NA)
	Grey seal*		Medium (low)	Minor adverse (minor adverse)	N/A	Not significant
	Harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
**Magnitudes and significance of effect in brackets are for the wider reference populations used in the assessment*						

10.12.1.8 Impact 6: Auditory injury and behavioural impacts from vessel noise

270. Vessel traffic within the WDA will increase during construction. There will be a maximum of 117 vessels operating within the WDA at any one time during the construction phase, and a maximum of 13 operating in the O&M phase with variations in vessel type and size depending on the specific activities being undertaken (see **Chapter 3 Project Description**).

271. Vessels operating within the WDA generally travel at low speeds or remain stationary, which reduces propulsion and cavitation noise and therefore results in comparatively low underwater noise emissions (Hildebrand, 2009; Ainslie, 2010). Research by Malme et al. (1989) and Richardson et al. (1995) indicates that the sound levels generated by large surface vessels are unlikely to cause auditory injury to marine mammals. This is supported by Southall et al. (2019), who report that typical vessel noise levels fall below the PTS criteria for marine mammals.

272. Jones et al. (2017a) reported that a cargo vessel approximately 126 m in length, travelling at 11 knots, could produce an average sound level of 160 dB re 1 µPa @ 1 m, with peak levels reaching 187 dB re 1 µPa @ 1 m. These levels may cause localised behavioural disturbance depending on ambient noise conditions.

273. Benhemma-Le Gall et al. (2021) observed reduced harbour porpoise activity during construction at the Beatrice and Moray East offshore windfarms. Porpoise detections decreased by 35.2% at 2 km from construction, 24% at 3 km, and increased by 7.2% at 4 km, suggesting a behavioural response within a 4 km radius. These observations coincided with multiple construction activities and the presence of support vessels.

274. For all phases of the Project, auditory injury (TTS) and disturbance has been assessed for all receptors.

10.12.1.8.1 Sensitivity

275. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.8.2 Magnitude of Impact

10.12.1.8.2.1 Underwater Noise Modelling

276. To assess for potential auditory injury from underwater noise from the presence of vessels, underwater noise modelling has been undertaken (see **Appendix 10.1 Underwater Noise Modelling Report**).

277. A simplified propagation model was used, incorporating measured sound source data that was adjusted to reflect the environmental and operational conditions specific to the WDA. In line with the auditory weighting criteria outlined by Southall et al. (2019), source level reductions were applied to each noise source to ensure accurate representation of potential impacts. Further details are available in **Appendix 10.1 Underwater Noise Modelling Report**.

10.12.1.8.2.2 Auditory Injury

10.12.1.8.2.2.1 <u>Construction</u>

278. It is unlikely PTS will occur from vessel activity within the WDA, as receptors would need to be in close proximity to the noise source which is unlikely as marine mammals are likely to be passing by

or fleeing from the area where there is an increase in vessel activity as described in **Section 10.12.1.7.**

279. Predicted PTS impact ranges from the presence of vessels is 60 m for harbour porpoise and less than 50 m for all other marine mammals (stationary and fleeing (**Table 10.46**). The predicted PTS impact range for delphinids, mysticetes and pinnipeds is less than 50 m, indicating that PTS is not expected to occur, as the hearing threshold is non-exceedance. Therefore, PTS has only been assessed for harbour porpoise. However, as harbour porpoise represents the most sensitive receptor to underwater noise, the magnitude of impact may be applied to all other receptors as a precautionary measure.

280. Predicted TTS ranges for fleeing receptors are less than 50 m, however TTS ranges vary with vessel size and marine mammal hearing group (see **Table 10.46**). The largest range for TTS is 1.5 km for harbour porpoise; however, this is highly precautionary as it is highly unlikely for any marine mammal to remain stationary in a noisy environment. For TTS to occur, marine mammals would have to be within the predicted impact area for approximately 24-hours for prolonged exposure to the underwater noise, however as discussed in **Section 10.12.1.7**, harbour porpoise are likely to move away from an area with increased noise/vessel activity.

281. **Table 10.47** presents the number of animals that could be exposed to auditory injury (TTS) from a single vessel operating in the WDA and with a maximum of 117 vessels operating in the WDA during construction. The assessment for auditory injury from multiple vessels is highly precautionary as it is multiplying the predicted impact ranges (for stationary marine mammals) by the number of vessels which will all remain within the WDA. If there are that many vessels within the WDA, all receptors will most likely flee from the area, making TTS less likely to occur.

282. The assessment for auditory injury from underwater noise from a single vessel is assessed as **negligible** for all receptors (**Table 10.47**). If the worst-case number of vessels were to be active in the WDA at the same time, the magnitude for up to 117 vessels in the WDA would be **low** for harbour porpoise and **negligible** for all other receptors.

*Table 10.46 predicted impact ranges (and areas) for PTS and TTS from 24-hour cumulative exposure to construction vessels for both a fleeing and a stationary receptor (impact ranges and areas used for the assessment are in **bold**)*

	Harbour porpoise (VHF)		**Delphinid species (HF) and Leatherback turtles**		**Mysticetes (LF)**		**Pinnipeds (PCW)**	
	PTS	**TTS**	**PTS**	**TTS**	**PTS**	**TTS**	**PTS**	**TTS**
	SEL_{cum} / $L_{E,p,t}$ Weighted (173 dB re 1 μPa^2s) Non-impulsive	**SEL_{cum} / $L_{E,p,t}$ Weighted (153 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (198 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (178 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (199 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (179 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (201 dB re 1 μPa^2s) Non-impulsive**	**SEL_{cum} / $L_{E,p,t}$ Weighted (181 dB re 1 μPa^2s) Non-impulsive**
Fleeing receptor								
Vessel noise (large)	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m
Vessel noise (medium)	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m	< 50 m
Stationary receptor								
Vessel noise (large)	< 50 m	130 m	< 50 m	< 50 m	< 50 m	440 m (0.6 km^2)	< 50 m	< 50 m
Vessel noise (medium)	60 m	**1.5 km (7.07 km^2)**	< 50 m	< 50 m	< 50 m	**280 m**	< 50 m	**100 m (0.031 km^2)**

Table 10.47 Maximum number of individuals (and % of reference population) as a stationary receptor that could be exposed to auditory injury as a result of underwater noise associated with increased vessel activities at the WDA during construction (NE: non exceedance and N/A: not applicable)

Species	TTS for one vessel		TTS from up to 117 vessels in WDA	
	Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (temporary)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (temporary)**
Harbour porpoise (PTS)	<1 (0.0002% WS MU)	Negligible	6 (0.02% NS MU)	Low
Harbour porpoise	3 (0.01% WS MU)	Negligible	348 (1.4% NS MU)	Low
Bottlenose dolphin	NE	NE	<1 (0.09% CWSH MU & 0.003% OW MU)	Negligible (CWSH MU & OW MU)
Common dolphin			<1 (0.001% CGNS MU)	Negligible
Atlantic white-sided dolphin			<1 (0.0002% CGNS MU)	Negligible
White-beaked dolphin			<1 (0.0006% CGNS MU)	Negligible
Risso' dolphin			<1 (0.0001% CGNS MU)	Negligible
Killer whale			<1 (0.01% WCC & 0.00001% NA)	Negligible (WCC & NA)
Long-finned pilot whale			<1 (0.00002% CGNS MU)	Negligible
Minke whale	<1 (0.001% CGNS MU)	Negligible	15 (0.15% CGNS MU)	Negligible
Fin whale	<1 (0.00004% NA)	Negligible	<1 (0.004% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible
Grey seal*	1 (0.0002% WS MU & 0.00005% Wider MU)	Negligible (negligible)	4 (0.02% WS MU & 0.008% Wider MU)	Negligible (negligible)
Harbour seal*	<1 (0.00001% WS MU & 0.000007% Wider MU)	Negligible (negligible)	<1 (0.001% WS MU & 0.0008% Wider MU)	Negligible (negligible)

Species	TTS for one vessel		TTS from up to 117 vessels in WDA	
	Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (temporary)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (temporary)**
Leatherback turtle	N/A	NE	N/A	Negligible
** Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.8.2.2.2 O&M

283. Vessel activity will occur during the O&M phase, with a maximum of 13 vessels operating in the WDA at any one time. Although fewer vessels will be present at the Project compared to the construction phase, potential effects from vessel activity will be over a longer time period, compared to it being temporary during construction. Therefore, the assessment criteria differs (see **Table 10.11**).

284. The assessment for auditory injury from underwater noise from a single vessel takes a precautionary approach using the predicted impact ranges for a stationary receptor. The magnitude is assessed as **low** for harbour porpoise, and **negligible** for all mysticetes and pinnipeds. Results from the underwater noise modelling (**Appendix 10.1 Underwater Noise Modelling Report**) show that there would be no impact to delphinids, which has been applied to leatherback turtle due to them having similar PTS/TTS thresholds (see **Table 10.15**). If the maximum number of vessels were to occur in the WDA at the same time (13), the magnitude is assessed as **medium** for harbour porpoise, **low** for bottlenose dolphin (CWSH MU), killer whale (WCC) minke whale and grey seal (WS MU) and **negligible** for all other receptors (**Table 10.48**).

10.12.1.8.2.2.3 Decommissioning

285. The presence of vessels is likely to increase during the decommissioning phase, although the exact scope is currently uncertain. However, the number of vessels is likely to be similar to the number required for construction. Therefore, any associated effects on all receptors are expected to be similar to, or less than, those assessed for the construction phase.

Table 10.48 Maximum number of individuals (and % of reference population) that could be exposed to auditory injury as a result of underwater noise associated with increased vessel activities at the WDA during the O&M (NE: non exceedance and N/A: not applicable)

Species	TTS for one vessel		TTS from up to thirteen vessels in WDA	
	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)
Harbour porpoise	3 (0.01% WS MU)	Low	502 (2.%.1% NS MU)	Medium
Bottlenose dolphin	NE	NE	<1 (0.1% CWSH MU & 0.004% OW MU)	Low (CWSH MU) Negligible (OW MU)
Common dolphin			1 (0.001% CGNS MU)	Negligible
Atlantic white-sided dolphin			<1 (0.0002% CGNS MU)	Negligible
White-beaked dolphin			<1 (0.001% CGNS MU)	Negligible
Risso' dolphin			<1 (0.0001% CGNS MU)	Negligible
Killer whale			<1 (0.01% WCC & 0.000008% NA)	Low (WCC) Negligible (NA)
Long-finned pilot whale			<1 (0.00002% NA)	Negligible
Minke whale	<1 (0.001% CGNS MU)	Negligible	22 (0.21% CGNS MU)	Low
Fin whale	<1 (0.00004% NA)	Negligible	<1 (0.006% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible
Grey seal*	1 (0.0002% WS MU & 0.00005% Wider MU)	Negligible (negligible)	5 (0.02% WS MU & 0.009% Wider MU)	Low (negligible)
Harbour seal*	<1 (0.00001% WS MU & 0.000007% Wider MU)	Negligible (negligible)	<1 (0.002% WS MU & 0.0001% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	NE	N/A -	Negligible
** Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.8.2.3 Disturbance

10.12.1.8.2.3.1 Construction

286. A maximum of 117 vessels could be operating within the WDA at any one time. Previous studies (see **Appendix 10.2: Marine Mammals and Leatherback Turtle Baseline Report**) show that harbour porpoise may be disturbed at distances of 2 to 5 km from the presence of vessel noise (Brandt et al., 2018; Rose et al., 2019; Benhemma-Le Gall et al., 2021; Benhemma-Le Gall et al., 2023). Benhemma-Le Gall et al. (2021) suggesting that significant responses are limited to within 4 km.

287. As a precautionary approach, assessment for all species has been considered a disturbance impact range of 4 km for all vessels. However, with the high number of vessels potentially working at the Project simultaneously, a 4 km buffer has been added to the WDA. This accounts for the maximum number of vessels operating inside the WDA, (see **Figure 10.1**). The worst-case disturbance area is therefore 851.8 km^2.

288. The magnitude for disturbance from a single vessel in the WDA is assessed as **medium** for bottlenose dolphin (CWSH MU), **low** for harbour porpoise and **negligible** for all other receptors (**Table 10.49**). If the maximum number of vessels were operating inside the WDA, the magnitude of disturbance would be **high** for bottlenose dolphin (CWSH MU) and killer whale (WCC), **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, minke whale and grey seal (both WS MU and wider MU). For all other receptors the magnitude of impact is assessed as **negligible** (**Table 10.48**).

289. Vessels transiting to and from the WDA can also cause disturbance to marine mammals and leatherback turtles. The port location(s) have not yet been decided however an indicative list of construction ports includes:

- Marshalling & Assembly (Construction):
  - Kishorn;
  - Arnish/Stornoway; and
  - Hunterston.
- Marine Operations (Construction):
  - Oban;
  - Port Ellen; and
  - Bendoran (Mull).

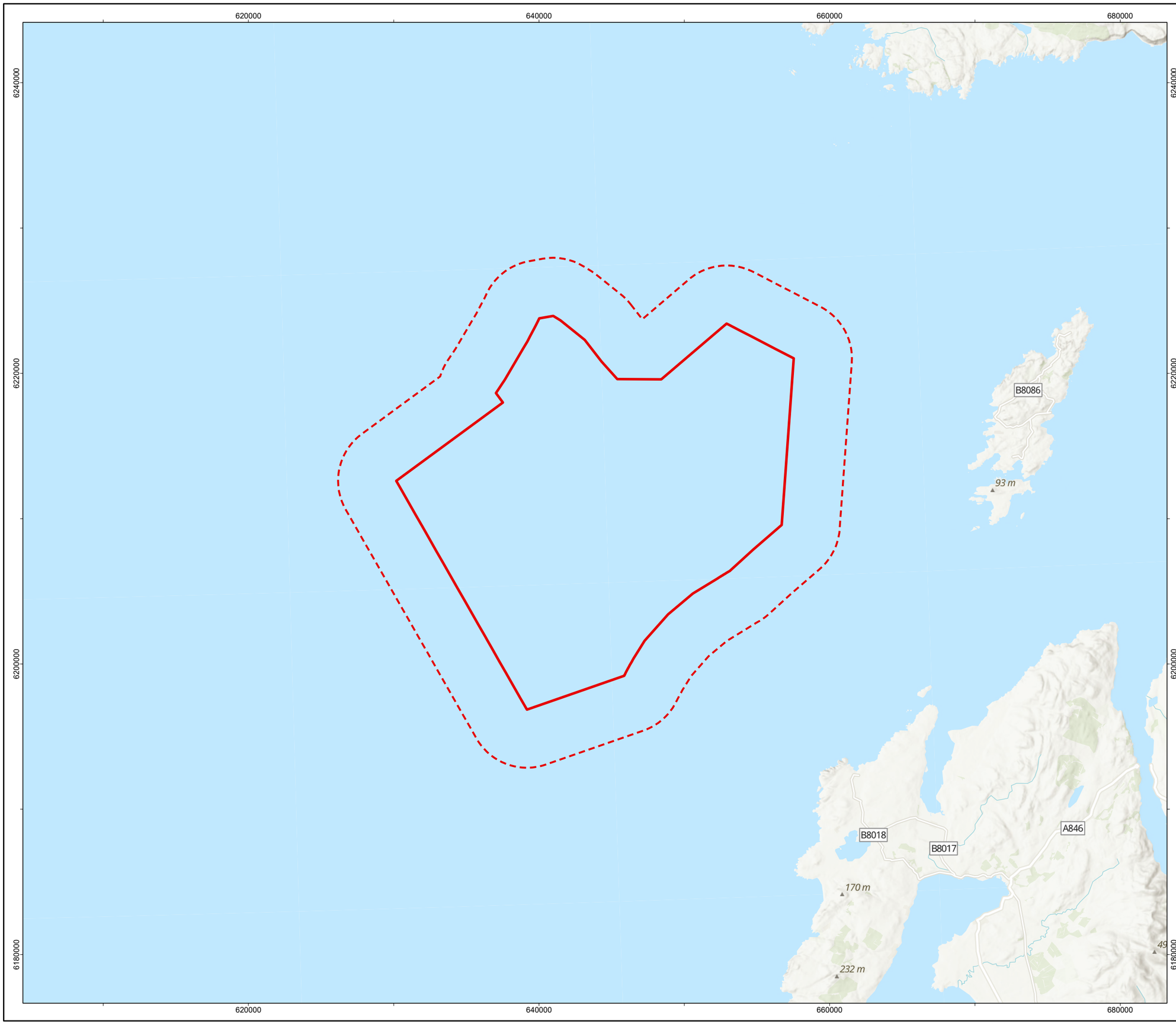
290. Arnish/Stornoway is the port at the greatest distance from the WDA, and therefore disturbance from transiting vessels has been assessed assuming Arnish/Stornoway port as a worst-case as it results in the largest disturbance area.

291. **Figure 10.2** illustrates the estimated vessel transit route with a 4 km buffer applied around the moving vessel from the WDA to Arnish/Stornoway. This assumes all receptors would be disturbed and/or displaced from the buffered area for an extended period following the vessel's passage. This represents a highly precautionary approach, as it is more likely that any disturbed individual would return to the area shortly after the vessel has transited through.

292. The impact range for the vessel has been calculated based on a single vessel with a 4 km disturbance range across the full transit route. The worst-case number of vessel round trips for the Project's construction phase is 5,699 which equates to an average of three vessels transiting per day, based on a five-year offshore construction period. Vessel transits are likely to be relatively

discrete (i.e. not all coming from the same port of origin) with limited spatial or temporal overlap. Therefore, the total impact area for disturbance from a single transiting vessel per day of 2,211.3 km^2 is considered to be suitably precautionary for the purposes of this assessment, particularly given the assumption of complete disturbance throughout the entire transit route (see **Figure 10.2**).

293. **Table 10.50** presents the magnitude of impact for disturbance. The magnitude for disturbance from a single transiting vessel from the WDA during the construction phase is assessed as **high** for bottlenose dolphin (CWSH), killer whale (WCC) and grey seal (WS MU). For bottlenose dolphin (OW MU), the magnitude is assessed as **medium**. The magnitude is assessed as **low** for harbour porpoise, common dolphin, white-beaked dolphin, minke whale, and grey seal (wider MU) (**Table 10.50**). For all other receptors, the magnitude has been assessed as **negligible**.

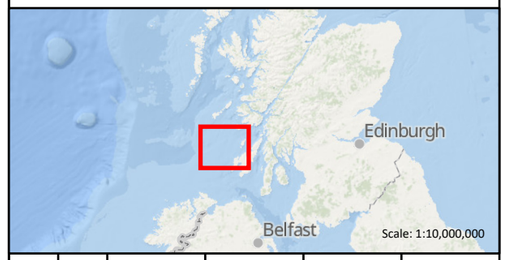


Windfarm Development Area

Windfarm Development Area 4km Buffer

N

0 5 10 Kilometres



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
2	26/03/2026	FC	AB	SB	PM

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000133

DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:250,000	PAGE SIZE	A3

PROJECT TITLE: MachairWind

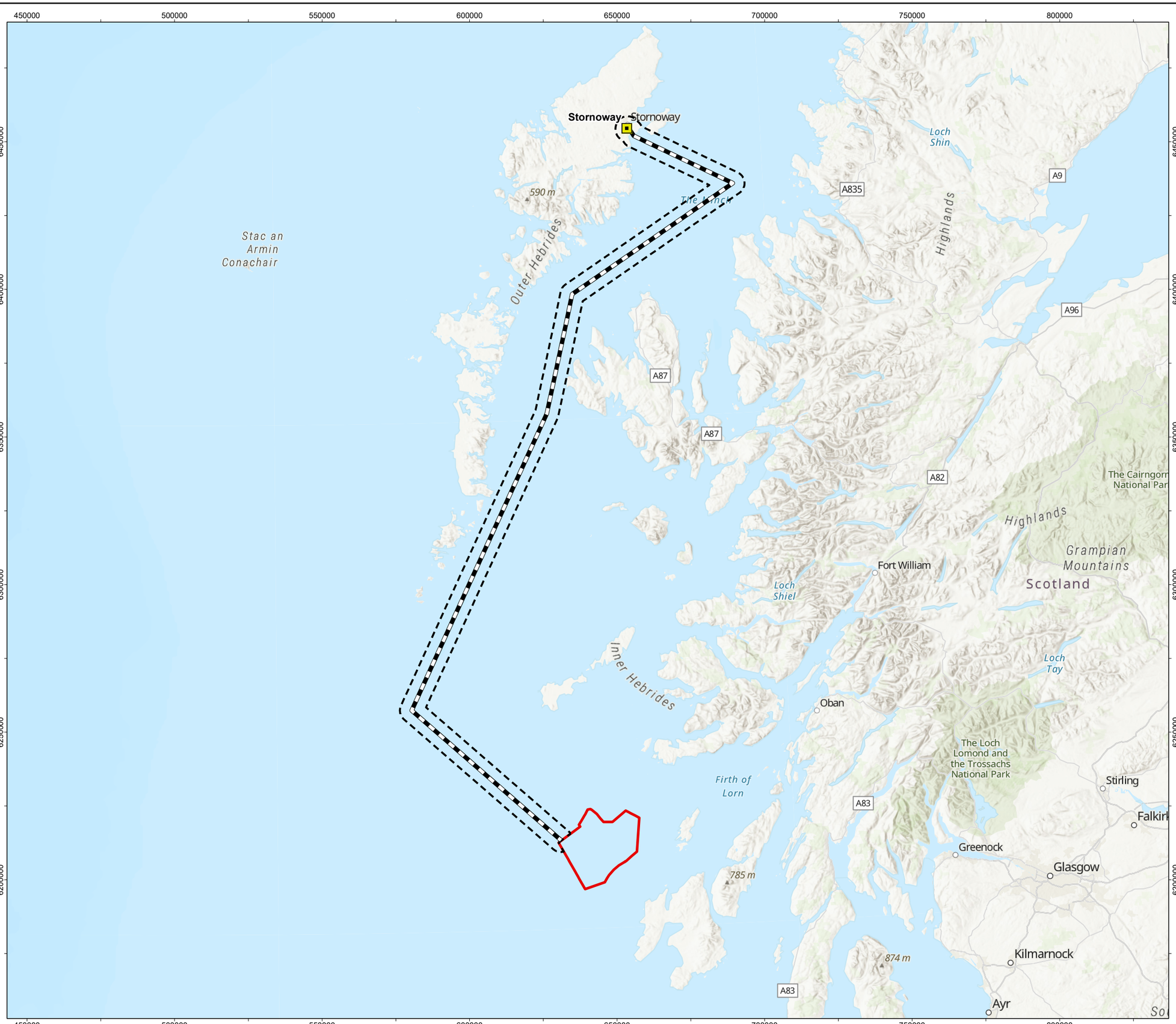
Figure 10.1: Disturbance Area of 4km Buffer around the WDA to Represent a Worst Case of 117 Vessels Operating in the WDA during the Construction Phase

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Service Layer Credits: World_Hillshade: Esri, Ordnance Survey, NASA, NGA, USGS
World Ocean Reference: Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Ocean Base: Esri, GEBCO, Garmin, NaturalVue

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Windfarm Development Area

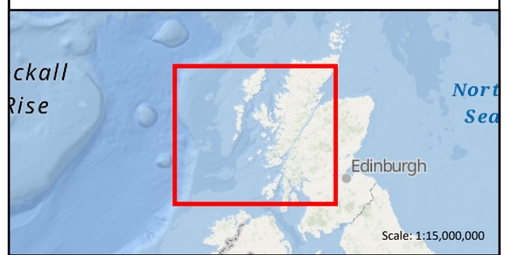
Stornaway Port

Transiting Vessel from Windfarm Development Area to Stornaway Port

Transiting Vessel from Windfarm Development Area to Stornaway Port 4km Buffer

N

0 5 10 20 30 40 50 60
Kilometres



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
2	22/04/2026	FC	GC	SB	PM

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000134		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:1,250,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		

Figure 10.2: Disturbance Area due to One Transiting Vessel during the Construction Phase

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World_Hillshade: Esri, CGIAR, N Robinson, NCEAS, USGS
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Table 10.49 Maximum number of individuals (and % of reference population) that could be exposed to disturbance as a result of underwater noise associated with increased vessel activities and/or non-piling activities at the WDA during construction

Species	Disturbance from one vessel and/or non-piling activities		Disturbance up to 117 vessels and/or non-piling activities	
	Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (temporary)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (temporary)**
Harbour porpoise	22 (0.09% WS MU)	Low	358 (1.6% NS MU)	Low
Bottlenose dolphin	3 (6.7% CWSH MU & 0.2% OW MU)	Medium (CWSH MU) Negligible (OW MU)	37 (82.2% CWSH MU & 2.8% OW MU)	High (CWSH MU) Low (OW MU)
Common dolphin	41 (0.07% CGNS MU)	Negligible	684 (1.2% CGNS MU)	Low
Atlantic white-sided dolphin	2 (0.02% CGNS MU)	Negligible	19 (0.2% CGNS MU)	Negligible
White-beaked dolphin	13 (0.04% CGNS MU)	Negligible	217 (0.6% CGNS MU)	Negligible
Risso' dolphin	<1 (0.006% CGNS MU)	Negligible	9 (0.1% CGNS MU)	Negligible
Killer whale	<1 (0.6% WCC & 0.0003% NA)	Negligible (WCC & NA)	<1 (10.6% WCC & 0.006% NA)	High (WCC) Negligible (NA)
Long-finned pilot whale	2 (0.001% NA)	Negligible	28 (0.02% NA)	Negligible
Minke whale	11 (0.1% CGNS MU)	Negligible	179 (1.7% CGNS MU)	Low
Fin whale	<1 (0.003% NA)	Negligible	2 (0.06% NA)	Negligible
Humpback whale	N/A	Negligible	N/A	Negligible
Grey seal*	44 (0.3% WS MU & 0.09% Wider MU)	Negligible (negligible)	737 (4.2% WS MU & 1.5% Wider MU)	Low (low)
Harbour seal*	4 (0.02% WS MU & 0.01% Wider MU)	Negligible (negligible)	68 (0.3% WS MU & 0.2% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	Negligible	N/A	Negligible
** Magnitudes in brackets are for the wider reference populations used in the assessment*				

Table 10.50 Maximum number of individuals (and % of reference population) that could be exposed to disturbance as a result of underwater noise associated with transiting vessels at the WDA during construction and O&M phase of the WDA

Species	Disturbance from one transiting vessel during construction (temporary)		Disturbance from one transiting vessel during O&M (long term effects)	
	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (temporary)	Assessment of impact (number of individuals and % of reference population)	Magnitude of impact (long-term)
Harbour porpoise	929 (3.8% WS MU)	Low	961 (3.9% WS MU)	Medium
Bottlenose dolphin	94 (100% CWSH MU & 7.2% OW MU)	High (CWSH MU) Medium (OW MU)	98 (100% CWSH MU & 7.5% OW MU)	High (CWSH MU & OW MU)
Common dolphin	1,775 (3.1% CGNS MU)	Low	1,837 (3.2% CGNS MU)	Medium
Atlantic white-sided dolphin	50 (0.4% CGNS MU)	Negligible	52 (0.4% CGNS MU)	Low
White-beaked dolphin	563 (1.7% CGNS MU)	Low	582 (1.7% CGNS MU)	Medium
Risso' dolphin	23 (0.3% CGNS MU)	Negligible	23 (0.3% CGNS MU)	Low
Killer whale	3 (37.5% WCC & 0.02% NA)	High (WCC) Negligible (NA)	3 (37.5% WCC & 0.02% NA)	High (WCC) Low (NA)
Long-finned pilot whale	72 (0.05% NA)	Negligible	75 (0.05% NA)	Low
Minke whale	465 (4.5% CGNS MU)	Low	481 (4.7% CGNS MU)	Medium
Fin whale	5 (0.2% NA)	Negligible	5 (0.2% NA)	Low
Humpback whale	N/A	Negligible	N/A	Low
Grey seal*	1,913 (11.0% WS MU & 3.8% Wider MU)	High (Low)	1,980 (11.3% WS MU & 3.9% Wider MU)	High (medium)
Harbour seal*	176 (0.9% WS MU & 0.5% Wider MU)	Negligible (negligible)	183 (0.9% WS MU & 0.5% Wider MU)	Low (low)
Leatherback turtle	N/A	Negligible	N/A	Low
** Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.8.2.3.2 O&M

294. During the O&M phase, the maximum number of vessels operating in the WDA at any one time would be 13. Potential disturbance from vessel activity will be long-term, compared to temporary as for construction, therefore the assessment criteria differ (**Table 10.48**).

295. The magnitude of disturbance from a single vessel for bottlenose dolphin (CWSH MU) is assessed as **high** (**Table 10.51**). The magnitude for disturbance from a single vessel is assessed as **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, Atlantic white-sided dolphin, white beaked dolphin, killer whale (WCC) minke whale, grey seal and harbour seal (both MUs). The magnitude is **negligible** for Risso's dolphin, killer whale (NA population), long-finned pilot whale, fin whale, humpback whale, and leatherback turtle.

296. The magnitude for disturbance from 13 vessels operating in the WDA is assessed as **high** for bottlenose dolphin (CWSH MU) and killer whale (WCC), **medium** for harbour porpoise, minke whale and grey seal (both MUs). The magnitude is assessed as **low** for common dolphin, Atlantic white-sided dolphin, white beaked dolphin, and harbour seal. For all other receptors the magnitude is assessed as **negligible** (**Table 10.51**).

297. Vessels transiting to and from the WDA can also cause disturbance. The O&M port location(s) has not been decided however an indicative list of port locations for the purposes of assessment is:

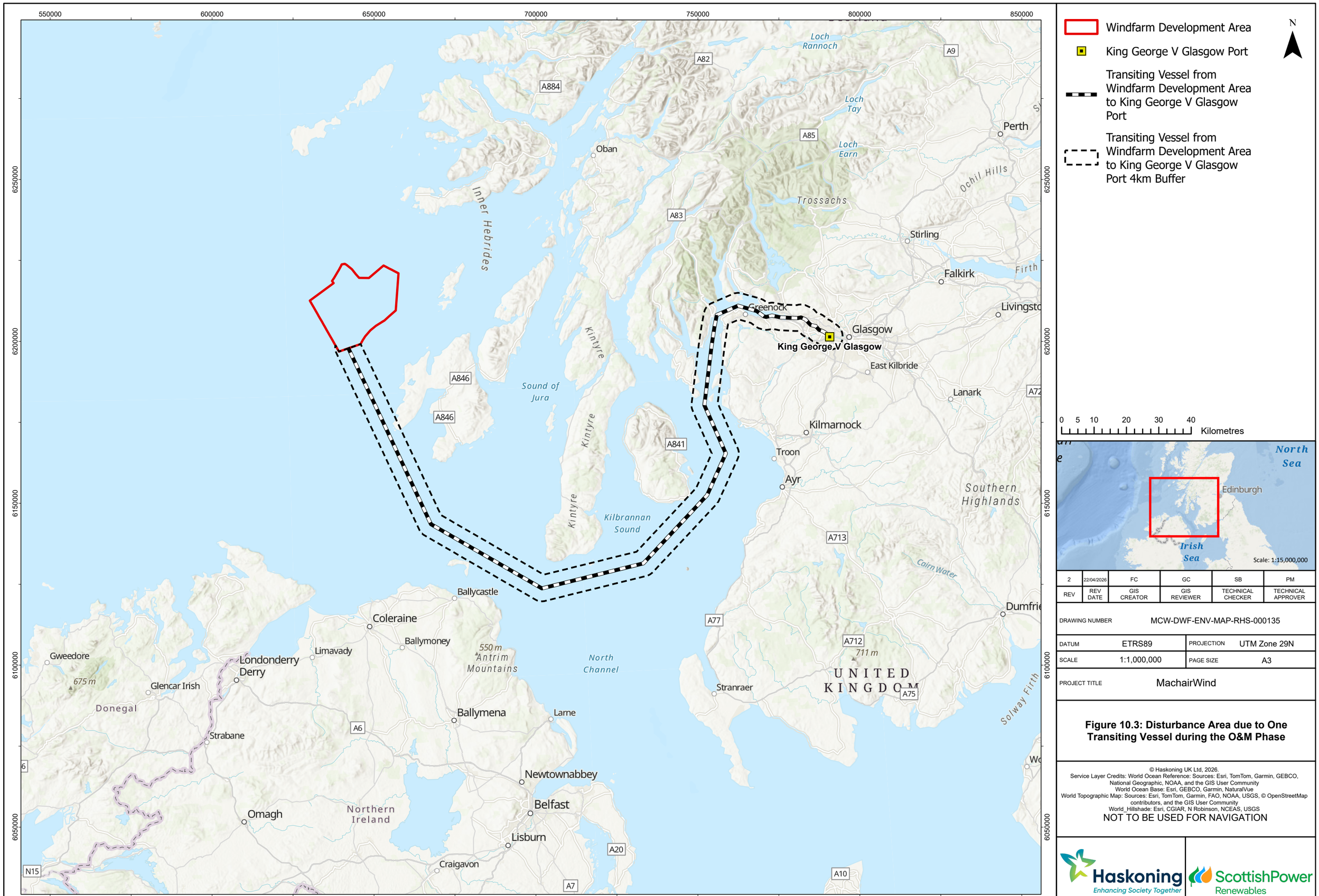
- Campbeltown/Machrihanish;
- King George V (Glasgow); and
- Hunterson.

298. **Figure 10.3** provides an indicative vessel transit disturbance area from the WDA to the worst-case port, which is King George V in Glasgow, as it is the furthest away from the WDA, therefore resulting in the greatest disturbance area. **Figure 10.3** shows the estimated vessel transit with a 4 km buffer around the moving vessel. This means that the assessment assumes marine mammals and leatherback turtle would be disturbed from the area of vessel transit for an extended period following the vessels transiting through the area. This is a highly precautionary approach as it is more likely that any marine mammal or leatherback turtle that is disturbed would return to the area shortly following the vessels' transit. The impact range for the vessel has been calculated based on a single vessel with a 4 km disturbance range across the full transit. The indicative annual vessel round trips during O&M is 423 which equates to an average of 1 vessel transiting per day. The total impact range for disturbance from a transiting vessel per day is 2,289 km^2 (see **Figure 10.3**).

299. **Table 10.50** presents the magnitude of impact of disturbance from transiting vessels during O&M. The magnitude for disturbance from a single transiting vessel from the WDA during the O&M phase is assessed as **high** for bottlenose dolphin (CWSH), killer whale (WCC) and grey seal (WS MU). The magnitude is assessed as **medium** for harbour porpoise, common dolphin, white-beaked dolphin, minke whale and grey seal (Wider MU). For all other receptors the magnitude is assessed as **low**.

10.12.1.8.2.3.3 Decommissioning

300. The number of vessels required during the decommissioning phase will be less or similar to the construction phase, therefore the magnitudes will be similar to what is presented in construction phase (**Section 10.12.1.8.2.3**).



2	22/04/2026	FC	GC	SB	PM
REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000135		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:1,000,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		

Figure 10.3: Disturbance Area due to One Transiting Vessel during the O&M Phase

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Service Layer Credits: World Ocean Reference: Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community
World Ocean Base: Esri, GEBCO, Garmin, NaturalVue
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World_Hillshade: Esri, CGIAR, N Robinson, NCEAS, USGS
NOT TO BE USED FOR NAVIGATION

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Table 10.51 Maximum number of individuals (and % of reference population) that could be exposed to disturbance as a result of underwater noise associated with increased vessel activities and/or non-piling activities at the WDA during O&M

Species	Disturbance from one vessel and/or and non-piling activities		Disturbance up to 13 vessels and/or and non-piling activities	
	Assessment of impact (number of individuals and % of reference population)	**Magnitude of impact (long-term)**	**Assessment of impact (number of individuals and % of reference population)**	**Magnitude of impact (long-term)**
Harbour porpoise	22 (0.09% WS MU)	Low	275 (1.3% NS MU)	Medium
Bottlenose dolphin*	3 (6.7% CWSH MU & 0.2% OW MU)	High (CWSH MU) Low (OW MU)	28 (62.2% CWSH MU & 2.1% OW MU)	High (CWSH MU) Medium (OW MU)
Common dolphin	41 (0.07% CGNS MU)	Low	525 (0.9% CGNS MU)	Low
Atlantic white-sided dolphin	2 (0.02% CGNS MU)	Low	15 (0.1% CGNS MU)	Low
White-beaked dolphin	13 (0.04% CGNS MU)	Low	167 (0.5% CGNS MU)	Low
Risso' dolphin	<1 (0.006% CGNS MU)	Negligible	7 (0.08% CGNS MU)	Low
Killer whale	<1 (0.6% WCC & 0.0003% NA)	Low (WCC) Negligible (NA)	<1 (8.1% WCC & 0.004% NA)	High (WCC) Negligible (NA)
Long-finned pilot whale	2 (0.001% NA)	Negligible	21 (0.01% NA)	Low
Minke whale	11 (0.1% CGNS MU)	Low	138 (1.3% CGNS MU)	Medium
Fin whale	<1 (0.003% NA)	Negligible	1 (0.04% NA)	Low
Humpback whale	N/A	Negligible	N/A	Low
Grey seal*	44 (0.3% WS MU & 0.09% Wider MU)	Low (low)	565 (3.2% WS MU & 1.1% Wider MU)	Medium (medium)
Harbour seal*	4 (0.02% WS MU & 0.01% Wider MU)	Low (low)	52 (0.26% WS MU & 0.16% Wider MU)	Low (low)
Leatherback turtle	N/A	Negligible	N/A	Low
** Magnitudes in brackets are for the wider reference populations used in the assessment*				

10.12.1.8.3 Significance of Effect

301. For the potential for auditory injury and disturbance from vessel presence, embedded mitigation includes (and will be in place for all phases of the Project);

- Best-practice measures such as following set vessel routes, keeping to minimum number of movements required, following the Scottish Marine Wildlife Watching Code (see **Table 10.8**; M-4 and **Appendix 6 Outline EMP**).

10.12.1.8.3.1 Auditory Injury (TTS)

10.12.1.8.3.1.1 Construction and decommissioning phase

302. The significance of effect for auditory injury (TTS) from multiple vessels during the construction and decommissioning phase (temporary) is presented in **Table 10.52** based on predicted impact ranges for stationary receptors. The significance of effect for temporary auditory injury (TTS) from one vessel is not presented as multiple vessels represents the worst-case scenario however for that impact, all receptors have a sensitivity of **medium** (**Table 10.14**), and the magnitude of impact is **negligible**, resulting in a significance of effect of **negligible adverse**, which is **not significant** in EIA terms.

303. For up to 117 vessels, the magnitude is assessed as **low** for harbour porpoise, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

10.12.1.8.3.1.2 *O&M phase*

304. For the O&M phase, where the effects will be long term, the magnitude of impact for auditory injury (TTS) from a single vessel, which, as above for construction and decommissioning, is not presented in **Table 10.52**, is assessed as **low** for harbour porpoise, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a significance of **negligible adverse**, which is **not significant** in EIA terms.

305. For auditory injury (TTS) for up to 13 vessels in the WDA, all receptors have a **medium** sensitivity, and the magnitude is assessed as **medium** for harbour porpoise, **low** for bottlenose dolphin (CWSH MU), killer whale (WCC) minke whale and grey seal (WS MU) and **negligible** for all other receptors. This results in a **moderate adverse** effect significance for harbour porpoise, which is significant in EIA terms. However, these magnitudes are assessed without mitigation. Embedded mitigation measures (as outlined above) will reduce any risk of exposure to underwater noise and disturbance. Therefore, with the inclusion of these mitigation measures the significance of effect is predicted to be **minor adverse**, which is **not significant** in EIA terms. For bottlenose dolphin (CWSH MU), killer whale (WCC) minke whale and grey seal (WS MU), the significance of effect is **minor adverse**, and for all other receptors **negligible adverse**, **not significant** in EIA terms (**Table 10.52**).

10.12.1.8.3.2 Disturbance

10.12.1.8.3.2.1 *Construction and decommissioning phase*

306. The significance of effect for all receptors from potential disturbance caused by up to 117 vessels operating in the WDA during the construction phase is consistent with that assessed for non-piling activities in **Section 10.12.1.7.4.2**, as both apply a 4 km disturbance range for the assessment.

307. During the construction and decommissioning phase of the WDA, disturbance from a single vessel in the WDA, for harbour porpoise, which has been assigned a **medium** sensitivity, the magnitude is assessed as **low** resulting in a significance effect of **minor adverse**, which is **not significant** in EIA terms. For bottlenose dolphin (CWSH MU) which has a low sensitivity, the magnitude of impact is

assessed as **medium** which results in an effect significance of **minor adverse**, **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible** resulting in a **negligible adverse** effect or **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.52**).

308. For disturbance for up to 117 vessels in the WDA during the construction phase, the magnitude has been assessed as **high** for bottlenose dolphin (CWSH MU) and the WCC killer whales, resulting in a moderate adverse effect, which is significant in EIA terms. However, professional judgement is applied to provide a more ecologically realistic interpretation, recognising an inflated scale of effects in the calculations and drawing on ecological expertise, as the initial moderate adverse assessment is considered overly precautionary. This is because the populations involved are relatively small (approximately 45 and eight individuals respectively) resulting in a higher relative proportion being affected. Additionally, all delphinids have been assigned a low sensitivity rating. Delphinids possess behavioural adaptations that enable them to alter direction and speed, avoid approaching vessels, and often habituate to vessel presence in areas of frequent traffic. For example, Mills et al. (2023) reported that bottlenose dolphins in the Corpus Christi Ship Channel (Texas) continued to engage in foraging (40%), travelling (24%), and socialising (15%) despite high vessel presence, with vessels within 300 metres during 80% of observations. This evidence suggests that applying a 4 km disturbance range for delphinids may be overly conservative.

309. As these assessments are without any mitigation, embedded mitigation measures (as outlined above) to reduce the risk of vessel collision and disturbance with marine mammals as secured through **Appendix 6 Outline EMP** (see **Table 10.8**) will reduce any risk of exposure to disturbance. Therefore, with the inclusion of these mitigation measures the significance of effect is more appropriately classified as **minor adverse**, which is **not significant** in EIA terms, for both bottlenose dolphin and killer whale. For harbour porpoise, bottlenose dolphin (OW MU), minke whale and grey seal (both populations) the magnitude is assessed as **low** which results in a **negligible** to **minor adverse** significance and for all other receptors the magnitude is assessed as **negligible** resulting in a **negligible adverse** significance of effect, **not significant** in EIA terms (**Table 10.52**).

310. Disturbance from vessels transiting from the WDA to port was assessed using the port furthest away as a precautionary approach. During the construction and decommissioning phase of the WDA, the magnitude has been assessed as **high** for bottlenose dolphin (CWSH MU), the WCC killer whales which both have a low sensitivity to disturbance. However, this is considered overly precautionary as set out in the above paragraph. Adherence to mitigation measures as secured through **Appendix 6 Outline EMP** (see **Table 10.8**) will reduce any risk of exposure to disturbance. Therefore, a significance of effect of **minor adverse** is predicted, which is **not significant** in EIA terms (**Table 10.52**). The magnitude has been assessed as **medium** for bottlenose dolphin (OW MU), **low** for harbour porpoise, common dolphin, white-beaked dolphin, minke whale and grey seal (wider MU) resulting in a **minor adverse** effect, **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms (**Table 10.52**).

10.12.1.8.3.2.2 ***O&M phase***

311. During the O&M phase of the WDA, with long-term effects, rather than temporary, for a single vessel, the magnitude is assessed as **high** for bottlenose dolphin (CWSH MU), with a low sensitivity, resulting in a moderate adverse effect, which is significant in EIA terms. However, for the reasons cited above for construction this is considered to be over-precautionary and accounting for embedded mitigation to reduce vessel collision and disturbance, an effect significance of **minor adverse**, **not significant** in EIA terms, is predicted with the inclusion of these mitigation measures (**Table 10.52**). The sensitivity for harbour porpoise and mysticetes is **medium**, and **low** for delphinids and pinnipeds. The magnitude has been assessed as **low** for harbour porpoise, bottlenose dolphin

(OW MU), common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, killer whale (WCC), minke whale, grey seal and harbour seal (both MUs) resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in **negligible adverse** effect which is **not significant** in EIA terms (**Table 10.52**).

312. For 13 vessels in the WDA during O&M, the magnitude is assessed as **high** for bottlenose dolphin (CWSH MU), killer whale (WCC) and grey seal (WS MU), and **medium** for harbour porpoise and minke whale, resulting in a moderate adverse effect, which is significant in EIA terms. However, for the reasons presented in **Paragraph 309** (i.e. the inclusion of best-practice measures in **Appendix 6 Outline EMP**), assigning the significance effect as moderate adverse is considered to be over precautionary and therefore an effect of **minor adverse** significance is predicted. The magnitude has been assessed a **medium** for grey seal (wider MU), resulting in a **minor adverse** effect, which is **not significant** in EIA terms. The magnitude is assessed as **low** for all other receptors, resulting in a **minor adverse** effect, which is **not significant** in EIA terms, with exception of killer whale (NA), which is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms (**Table 10.52**).

313. For transiting vessels during the O&M phase, the magnitude of disturbance has been assessed as **high** for bottlenose dolphin (CWSH and OW MU), killer whale (WCC) and grey seal (WS MU), and **medium** for harbour porpoise, common dolphin, white-beaked dolphin, minke whale and grey seal (wider MU), resulting in a moderate adverse effect, which is significant in EIA terms. However, for the reasons presented in **Paragraph 308** assigning the significance effect as moderate adverse is considered to be over precautionary, as the assessment does not account for embedded mitigation (see above), and therefore a magnitude of impact of **minor adverse** significance is predicted which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **low**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.52**).

10.12.1.8.3.3 Designated Sites

314. As shown in **Table 10.7**, several marine mammal designated sites could potentially be affected by increased vessel activity within the WDA during all phases of the Project. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted from underwater noise associated with vessel activities (**Table 10.52**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

315. For minke whale, a single designated site may be affected by vessel activities within the WDA and during transits: the Sea of the Hebrides NCMPA. Based on the NCMPA-specific minke whale density presented in the **Report to Inform the Marine Protected Area Assessment**, up to 78 individuals (3.18% of the NCMPA population) may be subject to disturbance from transiting vessels activities, however the assessment is highly conservative and does not account for the noise source to be moving rather than stationary. Therefore, it is concluded that increased vessel activity would not result in significant effects on the NCMPA.

316. For pinnipeds, several designated sites may be affected by increased vessel activity within the WDA and vessel transit to and from the WDA from port. These sites include the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey

and harbour seal at any of these designated sites due to an increase in vessel activity and transiting vessels (**Table 10.52**).

Table 10.52 Significance of effect from the potential for auditory injury and disturbance due to the increased vessel activities during construction and O&M (blue shaded cells = with embedded mitigation)

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Construction and Decommissioning Phases						
Auditory Injury (TTS from 117 vessels in the WDA for a stationary receptor)	Harbour porpoise	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU))	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
Disturbance from a single vessel in the WDA	Harbour porpoise	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin	Low	Medium (CWSH MU) Negligible (OW MU)	Minor adverse (CWSH MU) Negligible adverse (OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
	Minke whale, fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Not significant
	Leatherback turtle	Low	Negligible	Negligible adverse	N/A	Not significant
Disturbance from 117 vessels in the WDA	Harbour porpoise	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin	Low	High (CWSH MU) Low) (OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin		Low	Minor adverse	N/A	Not significant
	Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin & long-finned pilot whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		High (WCC) Negligible (NA)	Minor adverse (WCC) Negligible adverse (NA)	N/A	Not significant (WCC & NA)
	Minke whale, fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Not significant
	Grey seal*	Low	Low (low)	Negligible adverse (negligible adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
Disturbance from transiting vessels (Arnish/Stornoway port assessed as a worst-case)	Harbour porpoise & minke whale	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin	Low	High (CWSH MU)	Minor adverse[13] (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)

[13]Due to information presented in **Section 10.12.1.8.3.2**, assigning the significance of effect as moderate adverse is considered to be over precautionary.

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
			Medium (OW MU)			
	Common dolphin & white-beaked dolphin		Low	Minor adverse	N/A	Not significant
	Atlantic white-sided dolphin, Risso' dolphin & long-finned pilot whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		High (WCC) Negligible (NA)	Minor adverse[13] (WCC) Negligible adverse (NA)	N/A	Not significant (WCC & NA)
	Fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Not significant
	Grey seal*	Low	High (Low)	Minor adverse[13] (minor adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
O&M Phase						
Auditory Injury (TTS from 13 vessels in the WDA for a stationary receptor)	Harbour porpoise	Medium	Medium	Minor adverse[13]	N/A	Not significant
	Bottlenose dolphin		Low (CWSH MU) Negligible (OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, fin whale & humpback whale		Negligible	Negligible adverse	N/A	Not significant
	Killer whale		Low (WCC) Negligible (NA)	Minor adverse (WCC)	N/A	Not significant (WCC & NA)

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
				Negligible adverse (NA)		
	Minke whale		Low	Minor adverse	N/A	Not significant
	Grey seal*		Low (negligible)	Minor adverse (negligible adverse)	N/A	Not significant
	Harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
Disturbance from one vessel in the WDA	Same as for construction shown above.					
Disturbance from 13 vessels in the WDA	Harbour porpoise & minke whale	Medium	Medium	Minor adverse[13]	N/A	Not significant
	Bottlenose dolphin	Low	High (CWSH MU) Medium (OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin, Atlantic white-sided dolphin, Risso's dolphin & long-finned pilot whale		Low	Minor adverse	N/A	Not significant
	White-beaked dolphin		Medium	Minor adverse	N/A	Not significant
	Killer whale		High (WCC) Negligible (NA)	Minor adverse (WCC) Negligible adverse (NA)	N/A	Not significant (WCC & NA)
	Fin whale & humpback whale	Medium	Low	Minor adverse	N/A	Not significant
	Grey seal*	Low	High (medium)	Minor adverse[13] (minor adverse)	N/A	Not significant
	Harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
	Leatherback turtle		Low	Minor adverse	N/A	Not significant
Disturbance from transiting vessels (King George V port assessed as a worst-case)	Harbour porpoise & minke whale	Medium	Medium	Minor adverse[13]	N/A	Not significant
	Bottlenose dolphin	Low	High (CWSH MU & OW MU)	Minor adverse[13] (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Common dolphin & white-beaked dolphin		Medium	Minor adverse	N/A	Not significant
	Atlantic white-sided dolphin, Risso' dolphin & long-finned pilot whale		Low	Minor adverse	N/A	Not significant
	Killer whale		High (WCC) Low (NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Fin whale & humpback whale	Medium	Low	Minor adverse[13] (negligible adverse)	N/A	Not significant
	Grey seal*	Low	High (medium)	Minor adverse[14] (minor adverse)	N/A	Not significant
	Harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Leatherback turtle		Low	Minor adverse	N/A	Not significant
Magnitudes and significance of effect in brackets are for the wider reference populations used in the assessment						

10.12.1.9 Impact 7: Barrier Effects due to Underwater Noise

317. Underwater noise during construction has the potential to create a barrier effect, preventing movement or migration of marine mammals and leatherback turtles between important feeding and / or breeding areas, or potentially increasing swimming distances if animals avoid the area.

318. MachairWind WDA is approximately 12.4 km from Colonsay at the closest point, 15 km from Islay, 20 km from Mull, 21 km from Iona, 30 km from Jura, 35 km from Tiree, 50 km from Coll, 65 km from mainland Scotland and approximately 68 km from mainland Northern Ireland at closest points. The WDA is not located in any known migration routes for marine mammals or turtles.

319. Potential barrier effects could arise if access to foraging areas is restricted, for all receptors moving between areas while following prey, and for pinnipeds travelling to and from protected seal haul-out sites.

10.12.1.9.1 Sensitivity

320. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.9.2 Magnitude of Impact

10.12.1.9.2.1 Construction

321. Underwater noise generated during construction and non-piling activities within the WDA can create acoustic barriers for marine mammals and leatherback turtle. In semi-enclosed coastal environments, this avoidance behaviour can lead to entrapment, where individuals become confined between noise sources and shoreline boundaries. Such scenarios increase energy expenditure, elevate stress levels, interfere with communication and navigation, further limiting the ability of animals to exit these areas.

322. Elevated noise levels may reduce the effective communication range for cetaceans and interfere with echolocation, limiting their ability to navigate, forage, and maintain social cohesion. For species that rely on acoustic cues for orientation or prey detection, persistent noise can lead to avoidance of noisy areas, effectively fragmenting habitats and restricting access to critical feeding or migratory routes. Such displacement may increase travel distances and energy expenditure, with potential consequences for health and reproductive success. As the WDA is located in a coastal region, there is a risk that underwater noise (loud and impulsive noise such as piling and high order detonation for UXO clearance) could cause a barrier and/or entrapment to any receptor, trapped inshore

323. **Figure 10.4**, presents the underwater noise modelling contour outputs for all receptor hearing groups, from all modelled locations; up to a level of 145 dB re 1 µPa. The 145 dB noise contour has been used to assess potential barrier effects, as Graham et al. (2017) reported a 50% probability of behavioural response in cetaceans at this received noise level. This threshold is therefore considered the most appropriate for presenting potential barrier effects. Noise levels below this threshold are not considered likely to result in a barrier effect; while lower-level noise may cause behavioural disturbance or annoyance, it is not expected to impede movement or result in habitat fragmentation for receptors.

324. Based on this approach, the maximum spatial area of effect is from the west modelling location, 10,237.51 km^2, followed by the north of 8,444.56 km^2; the south; 7,513.36 km^2 and the north-east

5,216.31 km^2. Although these appear large, at the 145 dB levels, the effect should be minimal with a 50% probably of a behavioural response. Additionally, **Figure 10.4** shows that there are numerous exit points, following vessel tracks between the islands, and a sufficient amount of space to travel and to avoid entrapment.

325. As a precautionary approach, the magnitude is assessed as **low** for all receptors, as there is the potential for underwater noise to cause barrier effects. However, any barrier effect will be temporary and short in duration. All receptors are wide ranging and can find alternative routes and foraging areas outside of the WDA.

10.12.1.9.2.2 O&M

326. The magnitude of impact will be less than what has been assessed in the construction phase, as there will be no loud impulsive noise sources from piling or UXO clearance, and vessel activity will be greatly reduced from the maximum of 117 vessels in the WDA during construction to a maximum of 13 during the O&M phase (see **Section 10.12.1.9.2.1**).

327. Operational noise from operating WTG is not expected to give rise to barrier effects for marine mammals and leatherback turtle. This is because noise levels during normal operation remain well below established disturbance thresholds, are continuous and non-impulsive in nature, and have a highly localised acoustic footprint. These characteristics allow receptors to detect, avoid, or habituate to the noise, and their inherent mobility further reduces the likelihood of any disruption to movement or migration routes.

10.12.1.9.2.3 Decommissioning

328. The magnitude of impact will likely be less than or similar to what is assessed in the construction phase, see **Section 10.12.1.9.2.1**.

10.12.1.9.3 Significance of Effect

329. Overall, as a precautionary approach, the sensitivity for all receptors is **medium** (**Table 10.9**), and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms (**Figure 10.4, Table 10.53**). The predicted significance levels are precautionary, having been assessed without mitigation; the application of embedded mitigation measures would further reduce the predicted effects.

10.12.1.9.3.1 Designated Sites

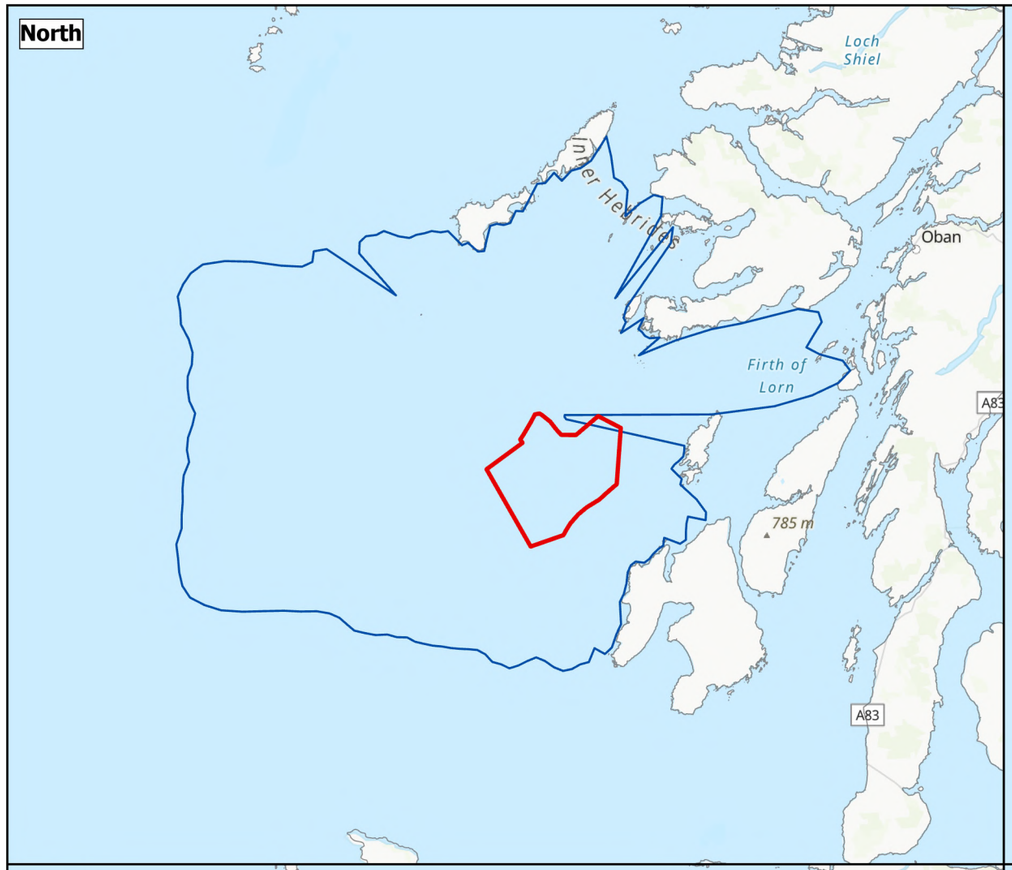
330. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by barrier effects due to underwater noise with piling and UXO clearance likely to be the worst-case. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted from barrier effects due to underwater noise (**Table 10.53**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

331. For minke whale, a single designated site may potentially be affected by barrier effects associated with underwater noise within the WDA: the Sea of the Hebrides NCMPA. Based on the NCMPA-specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment**, barrier effects resulting from underwater noise are considered unlikely due to the presence of numerous exit points from the NCMPA. Using a 145 dB noise contour, modelling

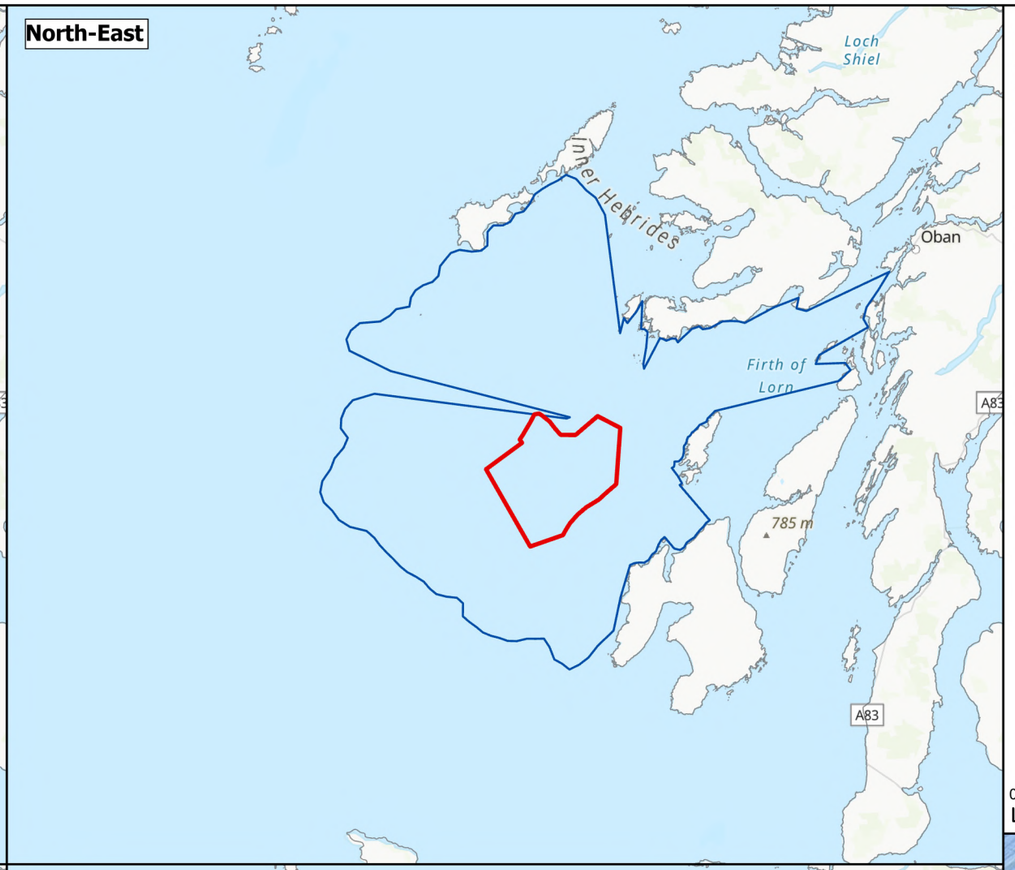
predicts that less than 50% of the NCMPA minke whale population would be expected to respond behaviourally to piling noise at this level. On this basis, it is concluded that increased vessel activity would not result in significant effects on the NCMPA.

332. For pinnipeds, several designated sites may be affected by barrier effects due to underwater noise within the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites from barrier effects due to underwater noise (**Table 10.53**).

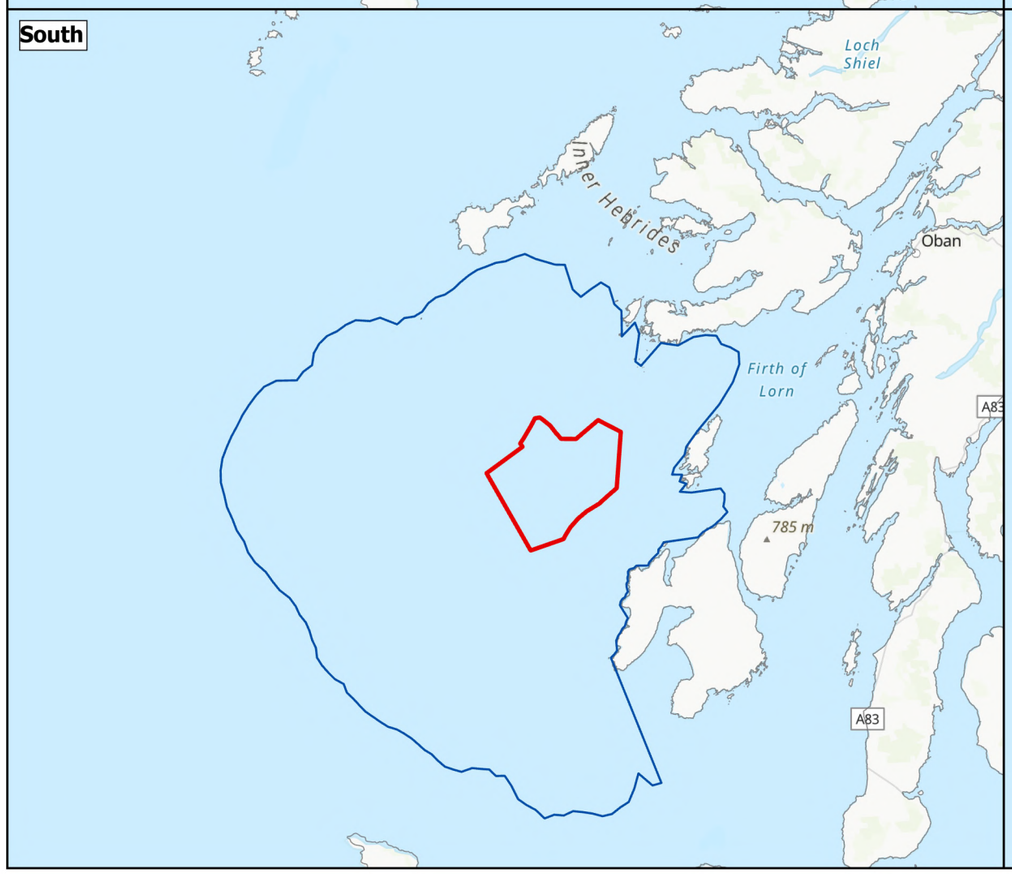
North



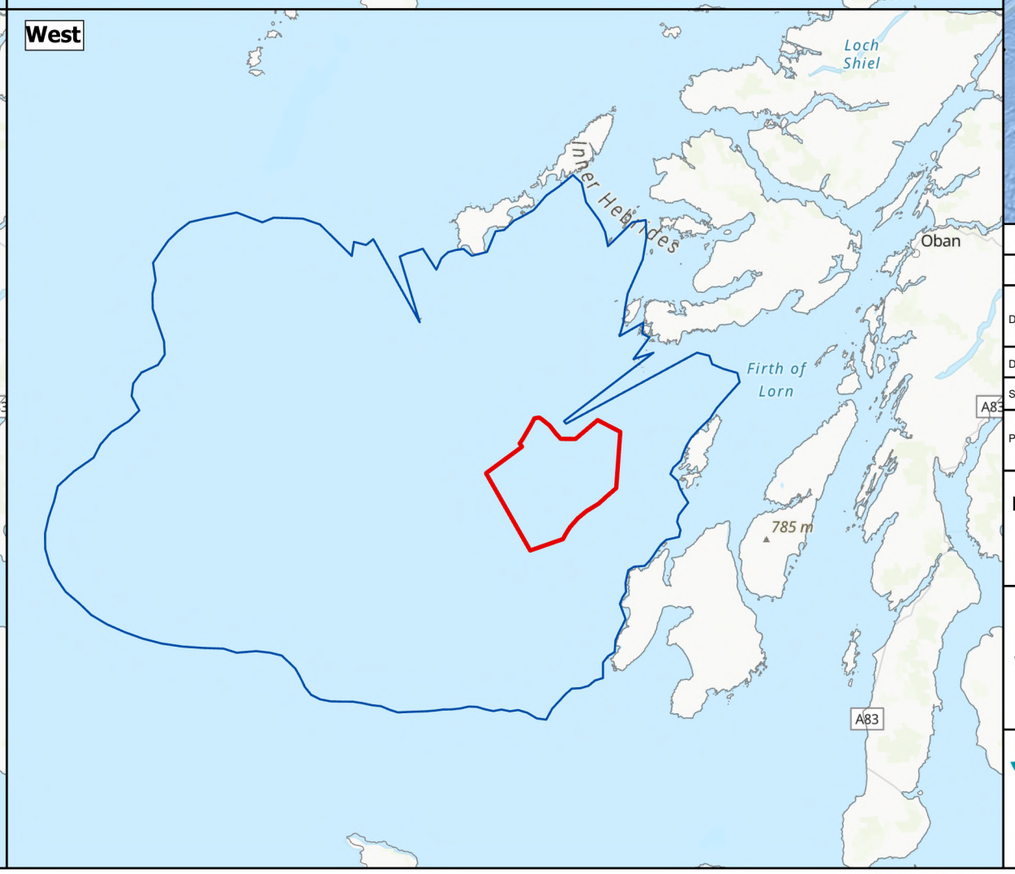
North-East



South



West



Windfarm Development Area

Underwater noise contour (145 dB)

N

0 25 50 Kilometres



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
2	30/03/2026	AB	GC	SB	PM

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000136		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:1,250,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		

Figure 10.4: Underwater noise contour file (145 dB) Presenting potential barrier effects from all modelled piling locations

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Service Layer Credits: World Ocean Reference: Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community
World Ocean Base: Esri, GEBCO, Garmin, NaturalVue
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

NOT TO BE USED FOR NAVIGATION

Haskoning Enhancing Society Together

ScottishPower Renewables

Table 10.53 Assessment of significance of effect for any potential barrier effects from underwater noise during all phases of the Project

Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Barrier effects from underwater noise during all phases	Harbour porpoise, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin		Low (CWSH MU & OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Killer whale		Low (WCC & NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Leatherback turtle		Low	Minor adverse	N/A	Not significant
** Magnitudes and significant effects in brackets are for the wider reference populations used in the assessment*						

10.12.1.10 Impact 8: Vessel interaction (collision risk)

333. Throughout the various phases of the WDA, vessel traffic to and from the site, as well as within the WDA, is expected to increase. However, it is anticipated that vessels will primarily use established shipping routes to access relevant ports, limiting the potential for any increased collision as marine mammals will be likely to avoid these well-established routes. To reduce the risk of vessel collisions with marine mammals, the Project's contractors will comply with an EMP in accordance with **Appendix 6 Outline EMP** which outlines specific procedures and guidance such as adherence to the Scottish Marine Wildlife Watching Code to reduce the potential for disturbance and collisions.

334. It is common for vessel collisions with marine wildlife to go unnoticed by the crew of larger vessels, however, all kinds of vessels have been documented to be involved in collisions with marine fauna, ranging from private yachts to whale watching boats, military vessels, and large commercial vessels such as cargos, ferries, and tankers (Van Waerebeek et al., 2007, Schoeman et al., 2020). Collisions involving larger ships tend to occur in areas where commercial shipping traffic is more intense, while those caused by small vessels tend to occur in high traffic areas such as marinas, inlets, and channels (Vighi, 2025). Regardless of their type and size, all vessels have the potential to collide with marine species, with the most lethal and serious injuries to whales usually being caused by large vessels (i.e., 80 m length or longer) and/or vessels travelling faster than 14 knots (Laist et al., 2001).

10.12.1.10.1 Sensitivity

335. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.10.2 Magnitude of Impact

10.12.1.10.2.1 Construction

336. During the construction phase there will be approximately 5,699 vessel round trips across the full construction phase, transiting between the WDA to one of the ports listed in **Section 10.12.1.8.** Marine mammals and leatherback turtle are highly mobile and are able to detect and avoid vessels, which reduces the likelihood of direct collisions. However, when collisions do occur, especially with larger vessels, the consequences can be severe, and recovery from such impacts is often limited (IWC, 2024).

337. Detection and avoidance behaviours vary across species, and while many cetaceans can sense approaching vessels, factors such as vessel speed, size, and noise levels significantly influence collision risk. Larger vessels, such as cargo ships and cruise liners greater than 80 m in length, represent the greatest threat, with collisions often resulting in serious or fatal injuries (Laist et al., 2001; Keen et al., 2023; IWC, 2024). Research indicates that vessel speed plays a significant role in the likelihood of fatal collisions with marine mammals. The probability of a lethal strike increases from around 20% to 80% when vessel speed rises from 8 to 15 knots (Vanderlaan & Taggart, 2007; New England Aquarium, 2024). Importantly, serious injuries have also been documented at speeds as low as 2 to 5.5 knots, demonstrating that even slow-moving vessels can pose a risk (Conn & Silber, 2013).

338. In the UK, data from the Scottish Marine Animal Stranding Scheme (SMASS), the Cetacean Strandings Investigation Programme (CSIP) in the years 2011 to 2023 indicates that less than 3% of stranded small cetaceans (e.g., harbour porpoise, and delphinids) show signs of trauma potentially linked to vessel strikes. This figure rises to 16.6% for stranded whales, highlighting the disproportionate impact on larger species (CSIP, 2024, SMASS 2024); (**Table 10.54**). For harbour

porpoise, the 12 strandings linked to vessel strikes were taken from 1,013 postmortems, resulting in less than 1% of fatalities resulting from collision risk, where the percentage is slightly higher for mysticetes, 2.5% of minke whale fatalities, 16.6% for fin whale and 33.3% for humpback whale (CSIP, 2024, SMASS 2024); (**Table 10.54**). Although these percentages are elevated partly due to the smaller number of whale postmortems available, the pattern still highlights a disproportionately higher vulnerability in large whales. This reflects both their ecology, such as slower manoeuvrability and their increased likelihood of crossing major shipping routes, underscoring the need for targeted mitigation in regions where whale presence overlaps with vessel activity.

339. Injuries to delphinids caused by vessels are most commonly associated with smaller, fast-moving powerboats used for recreational activities. These craft can travel unpredictably at high speeds, increasing the likelihood of collisions or propeller injuries when dolphins surface or approach boats out of curiosity. A 2025 study led by Heriot-Watt University, conducted in partnership with WDC Shorewatch and the HWDT, found that small recreational craft are a major, largely unmonitored source of injury to small cetaceans within the Inner Hebrides (Hague et al., 2025).

Table 10.54 Summary of marine mammal and leatherback turtles strandings in UK waters from 2011 to 2022, and number of potential and confirmed vessel strikes (- means data deficient, (no post mortem or data not available))

Species	Number of strandings		Number of postmortems (PM)		Signs of traumatic injury (and % of PM)		Confirmed vessel strikes (and % of PM)
	CSIP	SMASS	CSIP	SMASS	CSIP	SMASS	CSIP/SMASS combined
Harbour porpoise	4,794	1,494	766	247	41 (<6%)	4 (<2%)	12 (0.7%)
Bottlenose dolphin	130	101	37	27	1 (<3%)	3 (<4%)	3 (2.3%)
Common dolphin	57	493	402	65	13 (<4%)	2 (<3%)	11 (2.0%)
Atlantic white-sided dolphin	48	41	11	7	-	1 (14.2%)	-
White-beaked dolphin	160	142	51	36	2 (<4%)	1 (<2%)	0
Risso's dolphin	112	85	18	12	1 (<6%)	-	1 (1.0%)
Killer whale	13	16	7	5	-	-	-
Long-finned pilot whale	277	234	74	74	-	-	-
Minke whale	247	174	34	23	-	1 (<5%)	5 (2.5%)
Fin whale	32	14	13	4	-	-	3 (16.6%)
Humpback whale	19	20	6	3	-	1 (33.3%)	1 (4.3%)
Grey seal	5,317	2,900	*	92	*	1 (1%)	1 (1%)
Harbour seal	721	847	*	117	*	-	-
Sea Turtles	128	23	-	0	-	-	1 (4.3%)
**Data unavailable*							

340. Although vessel collision is a risk, vessels working in the WDA are likely to be operating below 10 knots, which rarely causes fatal injuries, making speed reduction one of the most effective mitigation strategies (Laist et al., 2014; Keen et al., 2023). Enforcing speed reductions has been effective in

reducing vessel strikes particularly for endangered species like the NA right whale (NOAA, 2020; ORCA, 2024).

341. Predictable vessel movements are also key to reducing collision risk, as they allow marine mammals to anticipate and avoid interactions (Nowacek et al., 2001; Lusseau et al., 2003; Williams et al., 2006). Slower speeds not only give animals more time to react but also reduce underwater noise, improving their ability to detect vessels and maintain communication (Leaper, 2019; JNCC, 2025).

342. Analysis of the IWC Ship Strike Database reveals that mysticetes, particularly fin, humpback, and right whales, are the most frequently reported victims of ship strikes. However, data gaps remain, with 12.1% of cases lacking species identification, and smaller cetaceans often underrepresented due to reporting biases (Winkler et al., 2024).

343. Vessel activity has been shown to influence dolphin behaviour, with socialising and foraging observed in the presence of various vessel types. A study by Mills et al. (2023) in a busy Gulf of Mexico shipping channel suggested that vessel movements may enhance nutrient mixing, potentially increasing prey availability. In UK waters, bottlenose dolphins in Cardigan Bay, Wales, exhibit varying responses to vessel presence depending on vessel type and their level of habituation (Koroza & Evans, 2022). Resident dolphins in the area appear more tolerant of vessel disturbance than transient individuals (Hudson, 2014a). As of the latest assessments, no recorded ship strikes involving bottlenose dolphins in Cardigan Bay have been documented. In broader regional modelling, collision risk for bottlenose and common dolphins in the North Sea was found to be relatively low compared to harbour porpoises (Robbins, 2022). However, white-beaked dolphins showed high spatial overlap with vessel traffic, particularly during winter months (October to April) along the northeast coast of England (Robbins, 2022).

344. On the west coast of Scotland (including the Hebrides, the Minches and the Sea of the Hebrides SAC), there is long-term monitoring of cetacean occurrence, distribution and seasonal patterns by HWDT. Their datasets provide evidence of behavioural changes associated with vessel activity in Hebridean waters, particularly for minke whales, harbour porpoise and delphinids. Documented responses include changes in surfacing rates and movement patterns during periods of increased vessel activity, as well as localised avoidance or temporary displacement in response to vessel presence (Hartny-Mills, 2024), which will reduce the chance of any collision risk. Additionally, recent work led by Heriot-Watt University, undertaken in partnership with WDC and HWDT, highlights significant limitations of Automatic Identification System (AIS), which in turn constrain collision-risk and disturbance assessments (Hague et al., 2025). These limitations arise because AIS does not capture all vessel types or activities (particularly smaller vessels, survey craft and recreational traffic), and can contain spatial and temporal gaps, and does not reflect fine-scale vessel manoeuvring behaviour. Consequently, AIS-based analyses provide only a partial representation of vessel activity, which constrains confidence in collision-risk and disturbance assessments, particularly in coastal and nearshore environments (Hague et al., 2025).

345. A review of vessel disturbance literature concluded that most marine mammals are affected by vessel noise, with responses typical of avoidance or fleeing behaviour, especially in harbour porpoises (Benhemma-Le Gall et al., 2021, 2023; Frankish et al., 2023), although some species, such as seals, may tolerate or co-exist with vessel activity. In 2016 Sea Mammal Research Unit (SMRU) conducted a study to determine the likelihood of harbour seal injury occurring due to co-presence with large vessels within the Moray Firth (Onoufriou et al., 2016a). This study used telemetry data of harbour seal within the Moray Firth alongside vessel AIS data. The data indicated vessel and seal co-occurrence was high (defined as over 2,500 co-occurrence minutes per year) in very localised areas. However, there appeared to be no relationship between areas in high co-occurrence and incidences of injury (Onoufriou et al., 2016a).

346. Analysis of the cause of death for loggerhead turtles in Italian waters found that boat strikes were confirmed as the cause of death for 3.9% of individuals. When including possible boat strikes, a total of 6.4% of individuals could have died because of vessel collision (Casale et al., 2010), although it should be noted that this varied greatly between each region studied. Other studies found much higher mortality rates for vessel collision. For example, 23.66% of turtle strandings in the Canary Islands were found to be due to vessel strike (Oros et al., 2005). For leatherback turtles, there is little evidence available to accurately quantify the risk to marine turtles, most likely due to any collision events being unreported or unknown (e.g. Schoeman et al., 2020), however, any vessel collision has the potential to cause serious injury or mortality to individuals.

347. Although, there will be an increase in the number of vessels within the WDA, most vessels will be operating at very slow speeds, or stationary which greatly reduces the risk of any collision. Therefore, the magnitude has been assessed as **low** for all receptors.

10.12.1.10.2.2 O&M

348. Details regarding vessel collision risk with marine mammals is outlined in **Section 10.12.1.10.2.1**. The maximum expected annual number of O&M vessel round trips is 423, representing only a small proportion of the vessel activity present during construction. Consequently, the potential collision risk to all receptors during the O&M phase is substantially lower and remains unchanged for O&M vessel operations. The magnitude of impact is therefore assessed as low for all receptors.

10.12.1.10.2.3 Decommissioning

349. Details regarding vessel collision risk with marine mammals is outlined in **Section 10.12.1.10.2.1** and would be similar for decommissioning vessels.

350. The magnitude of impact is therefore considered to be **low** for all receptors.

10.12.1.10.3 Significance of Effect

351. For the potential for vessel collision risk, embedded mitigation includes (and will be in place for all phases of the Project);

- Best-practice measures such as following set vessel routes, keeping to minimum number of movements required, following the Scottish Marine Wildlife Watching Code (see **Table 10.8**; M-4 and **Appendix 6 Outline EMP**).

352. The sensitivity for harbour porpoise, minke whale, humpback, and fin whale has been assigned as **medium** (**Table 10.14**) and the magnitude is assessed as **low**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all delphinids, pinnipeds and leatherback turtle, the sensitivity has been assigned as **low**, and the magnitude is l**ow**, resulting in **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.55**).

10.12.1.10.3.1 Designated Sites

353. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by collision risk due to an increase in the number of vessels in the WDA. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted from collision risk (**Table 10.55**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

354. For minke whale, a single designated site may potentially be affected by l collision risk associated with an increase in the number of vessels in the WDA: the Sea of the Hebrides NCMPA. Based on

the NCMPA-specific minke whale assessment presented in **the Report to Inform the Marine Protected Area Assessment**, evidence indicates that reported ship-strike incidence for minke whales is lower than for some larger mysticetes, and collision risk is not currently considered a primary pressure on the species at the population level in Scottish waters (NatureScot, 2020; IWC, 2022), which includes the NCMPA population. On this basis, it is concluded that increased vessel activity would not result in significant effects on the NCMPA.

355. For pinnipeds, several designated sites may be affected by collision risk due to an increase in the number of vessels in the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites due to collision risk from vessels (**Table 10.55**).

Table 10.55 Assessment of significance of effect for vessel collision risk during all phases of the Project (blue shaded cells = with embedded mitigation)

Phase	Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
All phases	Vessel collision	Harbour porpoise, minke whale, fin whale & humpback whale	Medium	Low	Minor adverse	N/A	Not significant
		Bottlenose dolphin	Low	Low (CWSH MU & OW MU)	Minor adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
		Common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin & long-finned pilot whale		Low	Minor adverse	N/A	Not significant
		Killer whale		Low (WCC & NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
		Grey seal & harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
		Leatherback turtle		Low	Minor adverse	N/A	Not significant
** Magnitudes and significant effects in brackets are for the wider reference populations used in the assessment*							

10.12.1.11 Impact 9: Disturbance at protected seal haul-out sites

356. Grey and harbour seal are known to be sensitive to anthropogenic activities at haul-out sites, particularly during vulnerable periods such as pupping and moulting. Disturbance from vessel traffic, construction operations (including piling), and land-based approaches can trigger behavioural responses such as increased vigilance and flushing, where seals abruptly retreat to the water (Cates and Acevedo-Gutierrez, 2017; Paterson et al. 2019). This reaction can be energetically demanding, especially for pregnant females, individuals with pups or those moulting, when seals spend extended time ashore to support skin and fur regeneration. Haul-out sites are shown on **Figure 10.5**.

10.12.1.11.1 Sensitivity

357. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.11.2 Magnitude of Impact

358. The magnitude of impact for disturbance at seal haul-out sites will vary depending on the phase of the Project. In the construction phase, disturbance at protected seal haul-out sites can come from underwater noise due to piling and the presence of transiting vessels. The distance of the protected seal haul-out sites to the WDA is presented in **Table 10.56** and shows that all haul-out sites are over 10 km away. Therefore, there would be no spatial overlap of disturbance from non-piling construction activities. Therefore, disturbance from non-piling construction activities has not been included in this assessment.

10.12.1.11.2.1 Construction

10.12.1.11.2.1.1 Piling

359. The offshore construction phase for the WDA is expected to span up to five years, though it is more likely to be completed within a three to four year timeframe. The most acoustically intense activity would be piling, due to it both being a loud and impulsive noise. It should be noted that an unmitigated UXO high-order clearance is a similar sound source to piling. This assessment focuses on piling, due to the longer duration of the sound source and therefore it is considered the worst-case scenario compared to any UXO clearance. In addition, a refined assessment will be carried out within the marine licence application for UXO clearance to be submitted post-consent once there is greater certainty on the number and location of UXO.

360. Piling is long duration and is assumed, under a worst-case scenario, to occur over up to 32 days for monopiles or 82.3 days for pin-piles (**Table 10.5**), involving a single monopile installation in any 24-hour period and sequential installation of up to six pin-piles in any 24-hour period. As a worst-case, the assessment will focus on piling but is likely to be similar for UXO clearance (high order).

361. Protected seal haul-out sites are located relatively close to the WDA, with several situated within 25 km with Oronsay Strand at approximately 12.5 km being the closest (see **Table 10.56** and **Figure 10.5**). Russell et al. 2016 found a significant reduction in seals at haul-out sites up to 25 km away during piling at Sheringham Shoal Offshore Windfarm. Due to this proximity, these locations may be directly influenced by noise generated during piling activities. As a result, potential impacts on these haul-out sites within a 25 km distance of the WDA have been considered within the scope of this assessment.

362. Edren et al. (2010) recorded a varied response of grey and harbour seals at haul-out sites due to nearby pile driving activities from the Nysted Offshore Windfarm, which was constructed 4 km from the Rosand Seal Sanctuary. The site was used for moulting, breeding and pupping by both grey and harbour seal, however harbour seal remained within 50 km of the sanctuary all year, (Dietz et al., 2003), so the study focused on harbour seal. Analysis of time-lapse images showed no sudden reaction in the behaviour of seals hauling out in the Rødsand Seal Sanctuary as the pile driving in the windfarm began or when the seal deterrent was turned on, as seals frequently entered and left the haul-out site during the pile driving periods (Edren et al., 2010). However, there was a significant effect on seal haul-out behaviour when considering the wind, month and time of the day (Edren et al., 2010).

363. The smallest reduction in hauled-out seals was found during the moulting period in August which is when harbour seals are more dependent on land, and the largest reduction was observed in November (Edren et al., 2010). Any disturbance during the moult can be particularly costly. Paterson (2019) found that seals disrupted during moulting exhibited elevated metabolic rates and increased time spent at sea, which may prolong the moulting process and increase cumulative energy expenditure. These findings support the need for protective measures around key haul-out sites during sensitive periods to minimise disturbance and ensure seal welfare.

364. In addition, harbour seal showed no site fidelity as they moved to the other side of the sanctuary in ‘Gedser’, where some of the noise from piling may have been blocked from the sandbank (Edren et al., 2010). Pile driving at Nysted Offshore Windfarm, may have caused a reduction in the number of hauled-out seals, however there were no long-term impacts on the population, with the population showing a stable population growth rate, suggesting that seals didn’t abandon the area.

365. During the Sheringham Shoal Offshore Windfarm study, the Wash and North Norfolk Coast SAC is located approximately 20 km away, harbour seal were recorded to travel in and out of the wash during pile driving which suggests that the motivation to forage and to haul-out outweighed any displacement from piling (Hastie et al, 2015; Russell et al. 2016).

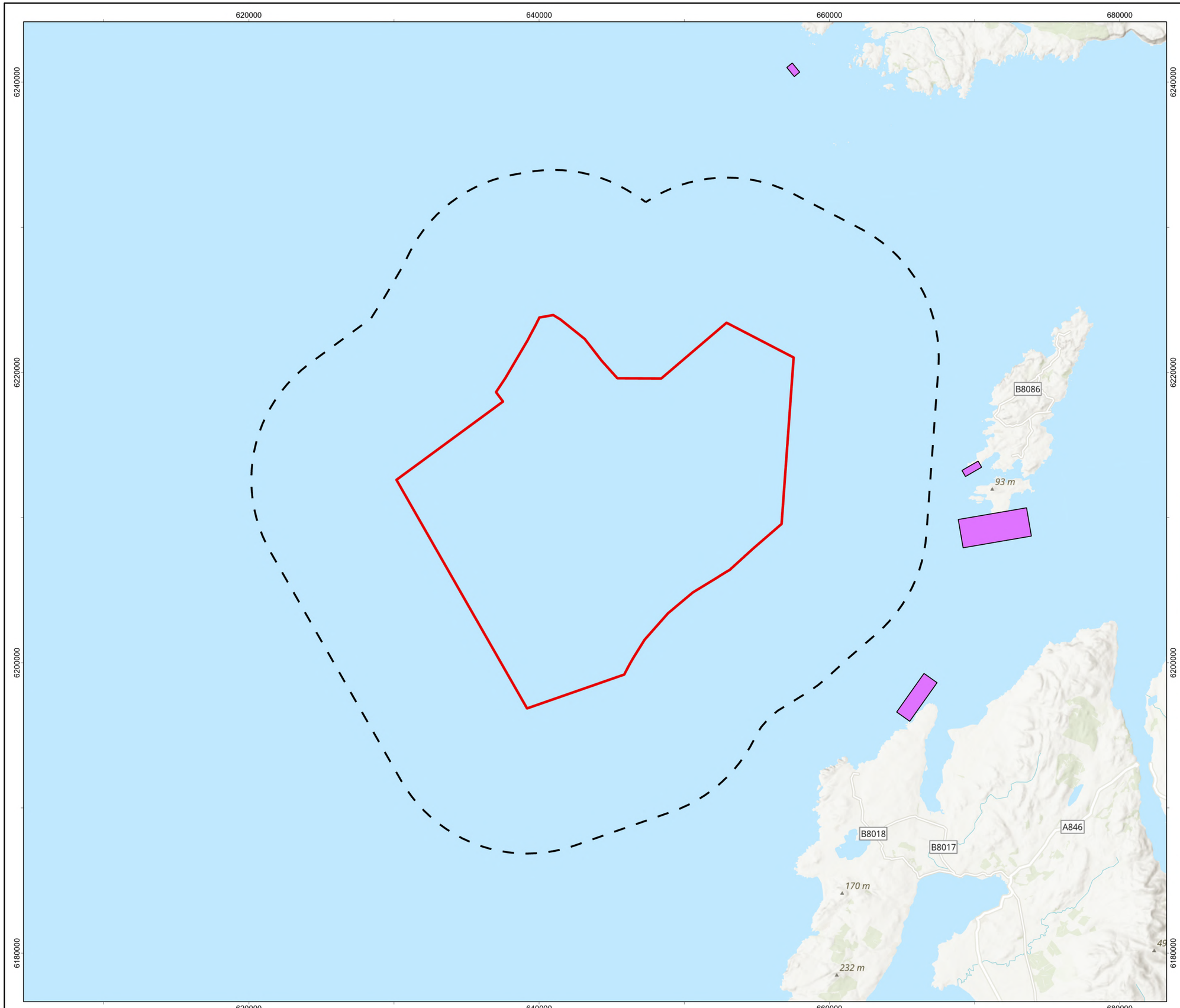
366. A full list of Protected seal haul-out sites is presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**. **Table 10.56** and **Figure 10.5** present the protected seal haul-out sites located within the vicinity of the WDA. A highly conservative 35 km ZoI has been applied, based on Russell et al. (2016), who documented that seals may be disturbed by piling noise at distances of up to approximately 25 km. The extension of the ZoI beyond the reported effect range provides an additional precautionary buffer to account for variability in sound propagation conditions, seal behavioural responses, and differences in piling characteristics between projects. This approach ensures that any potential disturbance is conservatively captured within the assessment and avoids the risk of underestimating the spatial scale of effects. The protected seal haul-out sites within vicinity of the WDA are therefore considered to provide a representative subset of all designated haul-out sites occurring at greater distances.

367. The protected seal haul-out sites within the vicinity of the WDA (**Table 10.56, Figure 10.5**) are all over 10 km away. Although underwater noise from piling will propagate in air and in water. In water, the level of impulsiveness (kurtosis) of the sound is known to decrease significantly in distances over 10 km (Southall et al., 2021). This can cause a change in the fundamental frequency weighting of the sound as well as the amplitude, resulting in less impact to seals in water with almost no impact to seals hauled-out based on the separation distance and sound propagation characteristics, underwater piling noise from the WDA is not expected to result in disturbance or behavioural effects on seals at protected haul-out sites.

368. The WDA is far enough away not to cause any risk to seals during the pupping seasons which are June to August for harbour seal and September to November for grey seal. Therefore, underwater noise associated with piling or UXO clearance activities within the WDA is not expected to result in disturbance to seals during pupping, and there is no risk of pup abandonment or haul-out disruption arising from these activities. The magnitude of impact on seal haul-out sites is therefore assessed as negligible, assessed as **negligible**.

Table 10.56 List of protected seal haul-outs sites in the vicinity of the WDA

Protected seal haul-out site name	Distance from WDA (km)	Site usage
Oronsay Strand	12.5	This site protects any species of seal, all year round/breeding
South Oronsay	13	This site protects any species of seal, all year round/breeding
Nave Island	15.5	This site protects any species of seal, all year round/breeding
Soa (Mull)	18	This site protects any species of seal, all year round/breeding
Outer Loch Tarbert	31.5	This site protects any species of seal, all year round/breeding



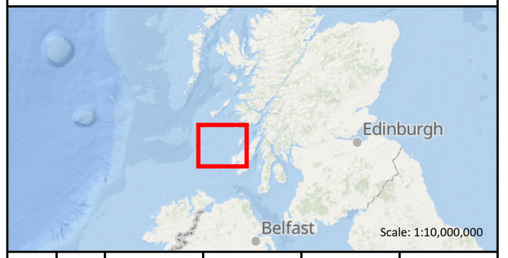
Windfarm Development Area

ZoI for disturbance of underwater noise impacts from piling

Protected Seal Haul-Out Site

N

0 5 10 Kilometres



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
2	29/04/2026	AB	GC	SB	PM

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SCALE	1:250,000	PAGE SIZE	A3
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Figure 10.5: Protected Seal Haul-out Sites in relation to the Windfarm Development Area

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10.12.1.11.2.1.2 Vessel disturbance

369. During the construction phase of the WDA, vessel activity will increase, with a peak estimate of up to 117 vessels operating in the WDA at any one time, with an average of three vessels transiting to port per day.

370. As stated in **Section 10.12.1.8.2.3** it is unknown which ports will be used during the construction phase, however, there is a list of indicative ports which include:

- Marshalling & Assembly (Construction):
  - Kishorn;
  - Arnish/Stornoway; and
  - Hunterston.
- Marine Operations (Construction):
  - Oban;
  - Port Ellen; and
  - Bendoran (Mull).

371. Increased vessel activity for construction could potentially cause disruption to hauled-out seals. In the UK, vessel presence has been observed to disturb seal haul-out sites up to 500 m away from site (Cates and Acevedo-Gutierrez 2017). In addition, Jansen et al., (2010), completed a similar study that concluded seals were 25 times more likely to fall into the waters when vessels were 100 m away compared to vessels 500 m away.

372. Research conducted by SMRU demonstrated that even repeated and direct vessel approaches to harbour seal haul-out sites did not result in long-term abandonment of these locations (Paterson et al., 2015). Using GPS tracking, the study found that seals responded to disturbances by temporarily relocating to nearby haul-out sites or engaging in foraging trips, but they consistently returned to their original locations, showing strong site fidelity.

373. Further investigations into the effects of vessel disturbance on hauled-out harbour seal support these findings. Even when disturbances were frequent and intense enough to cause seals to enter the water, there was no significant increase in relocation to alternative haul-out sites, nor were there notable changes in movement patterns or foraging behaviour (Paterson et al., 2019).

374. **Table 10.57** and **Figure 10.6** presents the protected seal haul-out sites that are in proximity of the probable track of the vessels transiting from MachairWind WDA to each port.

375. All vessel movements to and from any of these ports will be incorporated within existing vessel routes, where practicable. Taking into account the proximity of shipping lanes to and from existing ports, it is likely that seals hauled-out along these routes and in the area of the ports would be habituated to the noise, movements and presence of vessels.

376. It is expected that if there is any disturbance to seals at haul-out sites from vessel activities. effects would be short-term. For example, a 2019 study on harbour seals in Scotland found that 30 minutes after a disturbance event, seals return to 52% pre-disturbance levels at haul-out sites and 94% pre-disturbance levels four hours after a disturbance event (Paterson et al., 2019).

377. **Table 10.57** shows that the closest estimated distance for a vessel to be passing a protected seal haul-out site is approximately 2 km, if Kishorn port was utilised. Therefore, the magnitude of disturbance from transiting vessels is assessed as low, as 2 km is a significant amount of space to prevent any disturbance to seals at haul-out sites, including during sensitive periods such as breeding and pupping seasons. If Oban or Port Ellen were the selected ports for the Project, there are no protected seal haul-out sites within the vicinity of the estimated vessel tracks from the WDA.

Table 10.57 List of ports and protected seal haul outs on route of vessel tracks during construction (green text is known breeding/pupping sites)

Indicative Port	Protected seal haul-out and estimated distance from vessel track
Kishorn	• Hough Skerries > 10 km
	• Bereray > 10 km
	• Migulay > 10 km
	• Pabbay > 10 km
	• Sandray > 10 km
	• Hyskeir > 10 km
	• W canna > 10 km
	• Rubga Bholuim > 10 km
	• Inner Loch Eynon > 10 km
	• Inner Bagh nam Faoileann and loch chill Eireabhaigh > 10 km
	• Sound of Harris Islands > 10 km
	• An Ascarsaid as Deas > 10 km
	• Fladda- chuan > 10 km
	• Sgeir nam Moal > 10 km
	• Trodday > 10 km
	• Loch a'Bhraige 6 km
	• Pabay and Ardnish Peninsula 6 km
	• Kishorn Islands and Strome Islands 2 km
Arnish/Stornoway	• Hough Skerries > 10 km
	• Bereray > 10 km
	• Migulay > 10 km
	• Pabbay > 10 km
	• Sandray > 10 km
	• W canna > 10 km
	• Rubga Bholuim > 10 km
	• Inner Loch Eynon > 10 km
	• Inner Bagh nam Faoileann and loch chill Eireabhaigh > 10 km
	• Sound of Harris Islands > 10 km
	• W canna > 10 km
	• Fladda- chuan > 10 km
	• Sgeir nam Moal > 10 km
	• An Ascarsaid as Deas 9 km

Indicative Port	Protected seal haul-out and estimated distance from vessel track
	• Bhalamus 7 km
	• Aird Dhubh 6 km
Hunterston	• Sanda and sheep island < 10 km
	• Sound of Pladda Skerries 4.7 km
	• Lady Isle > 10 km
Oban	N/A
Port Ellen	N/A
Bendoran (Mull)	• Sea of Mull 7 km

10.12.1.11.2.2 O&M

378. During the O&M phase, the only potential risk of disturbance to protected seal haul-out sites is vessel disturbance. Any maintenance activity in the WDA, will result in no spatial overlap between the WDA and the protected seal haul-out sites. Therefore, this has not been included in the current assessment.

379. As stated in **Section 10.12.1.8**, it is unknown which ports will be used during the O&M phase, however, there is a list of indicative ports which include:

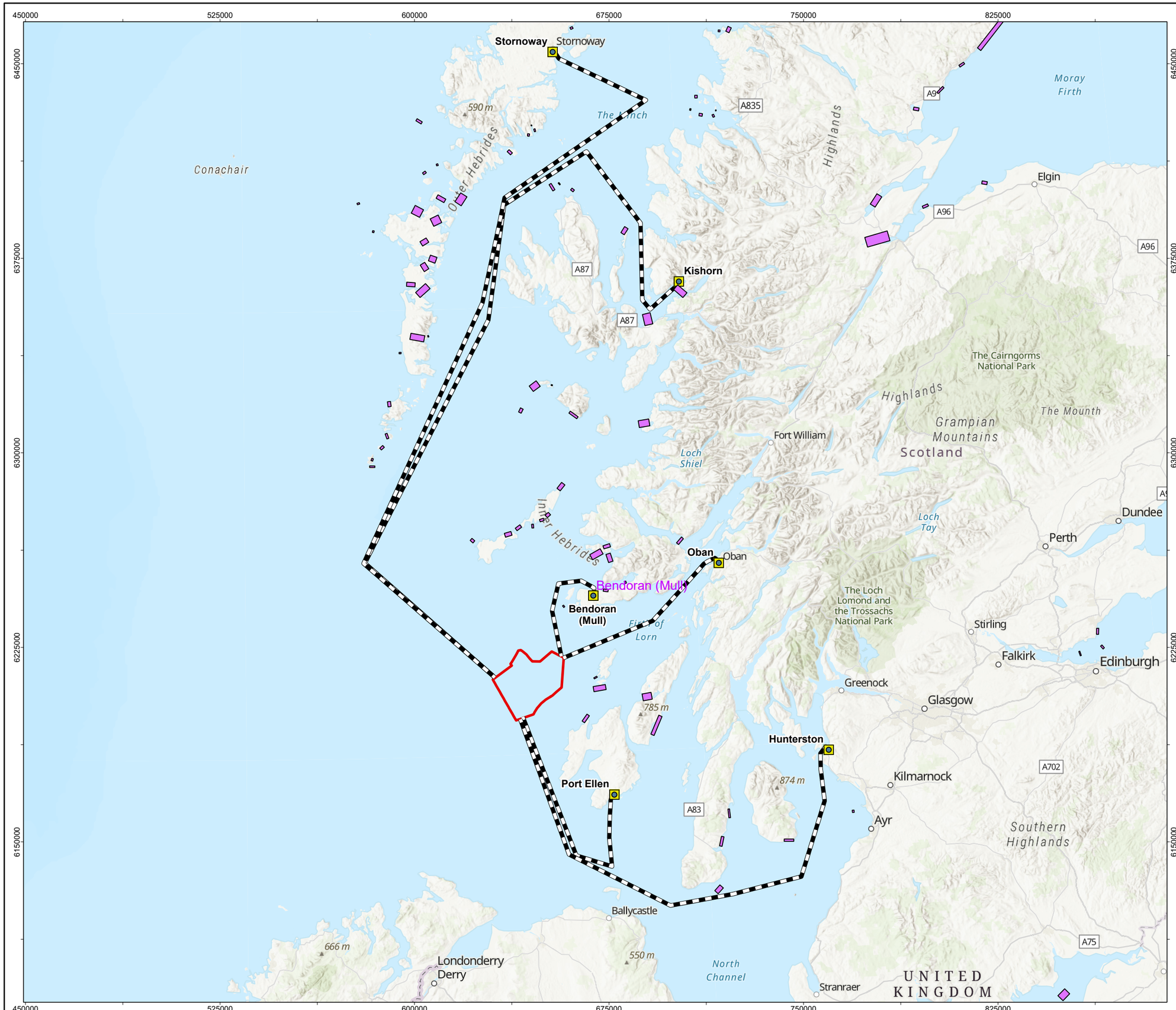
- Campbeltown/Machrihanish;
- King George V (Glasgow); and
- Hunterston.

380. In the O&M phase, a maximum of 13 vessels could be simultaneously active in the WDA, with an average of a one to two vessels transiting to port per day. However, it is unlikely for vessels to be transiting at the same time, and therefore the qualitative assessment will focus on one transiting vessel.

381. **Table 10.58** and **Figure 10.7** indicates that the minimum distance between the vessel transit route and the protected seal haul-out site is less than 5 km. Under the worst-case scenarios, including the use of King George V (Glasgow) or Hunterston ports, sufficient spatial separation remains to avoid disturbance to seals, even during sensitive periods such as breeding and pupping. Consequently, the magnitude of impact is assessed as **negligible**.

Table 10.58 List of ports and protected seal haul-outs on route of vessel tracks during O&M (green text is known breeding/pupping sites)

Indicative Port	Protected seal haul-out and estimated distance from vessel track
Glasgow	• Sanda and sheep island < 10 km • Sound of Pladua Skerries 4.7 km • Lady Isle 10 km
Hunterston	• Sanda and sheep island < 10 km
	• Sound of Pladda Skerries 4.7 km
	• Lady Isle > 10 km
Machrihanish	• Eilean Mhic Coinnich 9 km



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
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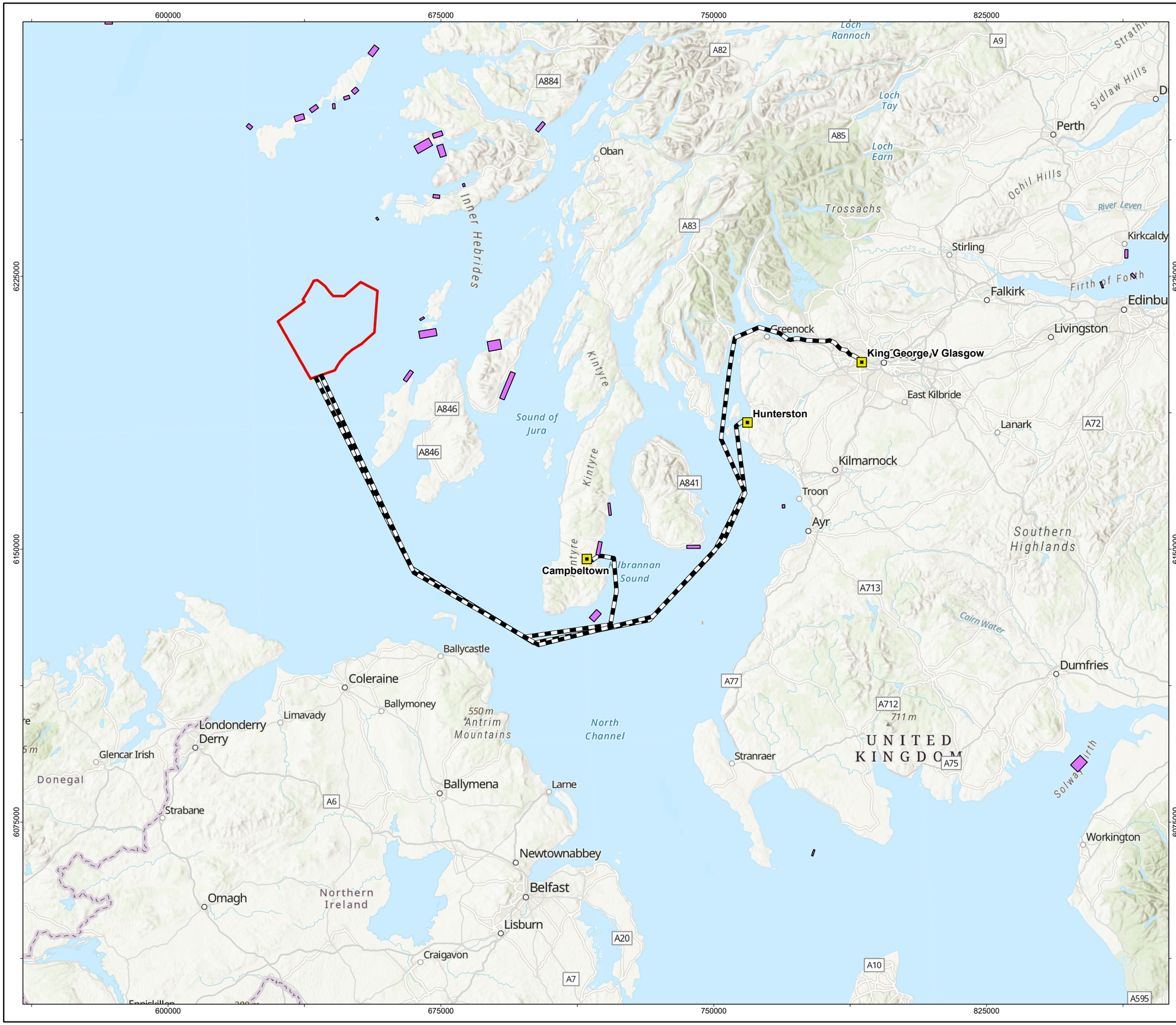
DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000137		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
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PROJECT TITLE	MachairWind		

Figure 10.6: Possible Vessel Tracks and Ports in Relation to Protected Seal Haul-out Sites During the Construction Phase

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SCALE	1:1,000,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		

Figure 10.7: Possible Vessel Tracks and Ports in Relation to Protected Seal Haul-out Sites During the O&M Phase

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10.12.1.11.2.3 Decommissioning

382. It is anticipated that similar ports to construction as presented in **Table 10.57** would be used, therefore the decommissioning effects would be similar to construction.

10.12.1.11.3 Significance of Effect

383. For the potential for disturbance at seal haul-out sites, embedded mitigation includes (and will be in place for all phases of the Project);

- Best-practice measures such as following set vessel routes, keeping to minimum number of movements required, following the Scottish Marine Wildlife Watching Code which includes maintaining 600 m distance from any protected seal haul-out sites during vessel transits to and from the Project (see **Table 10.8**; M-4 and **Appendix 6 Outline EMP**).

384. Overall, it is predicted that the sensitivity for disturbance at haul-out sites for both grey and harbour seal is **medium** (**Table 10.9**) and the magnitude of impact for piling is assessed as **negligible,** resulting in a **minor adverse** effect, which is **not significant** in EIA terms.

385. For the potential risk of disturbance from transiting vessels without mitigation, in the construction and O&M phase of the WDA, the magnitude is assessed as **negligible**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.59**). Embedded mitigation measures (see **Section 10.10**) presented in **Appendix 6 Outline EMP** will reduce any risk of exposure to disturbance.

10.12.1.11.3.1 Designated Sites

386. As shown in **Table 10.7**, several pinniped designated sites could potentially be affected by disturbance at protected seal haul-out sites, arising from underwater noise-generating activities and the presence of vessels. These sites include the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations qualifying these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey or harbour seal populations are predicted, no significant effects are anticipated for grey seal or harbour seal at any of these designated sites as a result of disturbance at protected seal haul-out sites (**Table 10.59**).

Table 10.59 Assessment of significance of effect for disturbance to protected seal haul-out sites during all phases of the Project (blue shaded cells = with embedded mitigation)

Phase	Impact	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Effect
Construction	Disturbance from piling	Grey seal & harbour seal*	Medium	Negligible (negligible)	Minor adverse (minor adverse)	N/A	Not significant
All phases	Disturbance from vessel activity	Grey seal & harbour seal*	Medium	Negligible (negligible)	Minor adverse (minor adverse)	N/A	Not significant
** Magnitudes and significant effects in brackets are for the wider reference populations used in the assessment*							

10.12.1.12 Impact 10: Changes to prey availability

387. Any impacts on prey species have the potential to indirectly affect marine mammals and leatherback turtle. As outlined in **Chapter 9 Fish (including Basking Shark) and Shellfish**, the potential impacts on fish and shellfish species during construction and decommissioning can result from:

- Temporary physical disturbance / habitat loss;
- Increased suspended sediment concentrations and sediment re-deposition;
- Underwater noise and vibration;
- Invasive non-native species; and
- Changes in fishing activity.

388. The potential impacts during O&M can result from:

- Introduction of hard substrate;
- Increased suspended sediment concentrations and sediment re-deposition;
- Underwater noise and vibration;
- Invasive non-native species;
- Changes in fishing activity;
- Permanent habitat loss; and
- EMF.

389. Due to the interaction between prey and marine mammals, the magnitudes of impact on fish receptors have been extracted from **Chapter 9 Fish (including Basking Shark) and Shellfish** and form the basis of the magnitude assessment for marine mammals and leatherback turtle.

10.12.1.12.1 Sensitivity

390. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.12.2 Magnitude of Impact

10.12.1.12.2.1 Construction

391. During construction, a range of temporary pressures will act on the marine environment; however, across all pathways, impacts are assessed as negligible to low for fish, shellfish, and marine mammals, with no significant effects predicted.

392. Temporary physical disturbance and habitat loss will occur primarily during foundation installation and associated seabed-contact activities. Disturbance is spatially limited and recovery begins immediately once works cease, with full stabilisation dependent on sediment type and natural hydrodynamic conditions. Fish, shellfish, and sandeel populations are expected to recolonise disturbed areas, and the magnitude of impact is assessed as negligible for all fish and shellfish. Therefore, the magnitude has been assessed as negligible for all receptors due to changes in prey availability from temporary disturbance and habitat loss for all receptors.

393. Increases in suspended sediment concentrations (SSCs) and sediment redeposition will be temporary and localised. As outlined in **Chapter 9 Fish (including Basking Shark) and Shellfish,** a maximum of 20,251,431 m³ of sediment is predicted to be mobilised, with most deposition remaining <5 cm, and so below common ecological thresholds for smothering of benthic eggs and early life stages. Only cable ploughing generates higher deposition, with 0.1–0.2 m within ~200 m and 0.2–0.3 m within ~100 m of the trench, while model artefacts predict up to 4 m near OSPs. Given

the dynamic, sand-dominated seabed, deposited material will rapidly redistribute and seabed levels will return towards baseline, resulting in a negligible magnitude of impact for fish, shellfish, spawning/burial grounds, and a negligible magnitude for all receptors due to changes in prey availability from SSCs.

394. Underwater noise and vibration, including piling may cause behavioural responses or temporary displacement in fish and shellfish. Effects have been assessed as low magnitude with respect to fish and shellfish receptors. On this basis, prey-mediated effects on marine mammals and leatherback turtle, arising indirectly through potential changes in prey availability, are also assessed as low magnitude, with no significant effects anticipated on prey resources.

395. Increased vessel activity and the introduction of hard substrate within the WDA during construction, O&M, and decommissioning has the potential to introduce and spread invasive non-native species (INNS). The substantial increase in vessel movements, particularly during construction, may facilitate INNS transfer via hull fouling, ballast water and equipment. Marine mammal prey species are typically mobile meaning direct INNS effects are limited and no impact on national conservation status is predicted. However, established or potential INNS (e.g. Pacific oyster and Japanese kelp) can alter ecosystem structure and food webs, leading to indirect effects such as reduced prey availability altered feeding opportunities and changes in movement or migration patterns. which could result in impacting prey availability for marine mammals and leatherback turtle. With the implementation of **Appendix 8 Invasive Non-Native Species Mitigation Plan**, effects on fish and shellfish receptors have been assessed as negligible magnitude. Consequently, prey-mediated effects on marine mammals and leatherback turtle, arising indirectly from potential changes in prey availability, are also assessed as negligible magnitude, with no significant effects on prey resources anticipated due to INNS.

396. As outlined in **Chapter 9 Fish (including Basking Shark) and Shellfish**, changes in fishing activity will arise from temporary 500 m safety zones around active construction areas. These zones will move across the WDA, creating short-term, localised restrictions. Static gear fleets may experience temporary displacement but have access to suitable alternative grounds. , and embedded mitigation reduces disruption (see **Appendix 5 Mitigation and Commitments Register**). Resultant changes in fishing pressure have been assessed as negligible magnitude for prey species, which would have no changes in prey availability for marine mammals and leatherback turtle. Therefore, any changes in prey availability due to changes in fishing activity is assessed as negligible for marine mammals and leatherback turtle.

10.12.1.12.2.2 O&M

397. Long-term habitat loss during operation will arise from the presence of foundations, scour protection and external cable protection, introducing hard substrate into an area otherwise dominated by sediment habitats. The total worst-case footprint is 6,788,230.51 m² (1.52% of the WDA) (see **Chapter 9 Fish (including Basking Shark) and Shellfish**), which is not significant given the abundance of similar habitat throughout the wider region. As any influence on marine mammals and leatherback turtles would only occur indirectly through changes in prey availability, and because suitable habitats remain widely available, the magnitude of long-term habitat loss is considered negligible for all receptors in relation to prey availability.

398. O&M activities may intermittently increase SSCs and cause limited sediment redeposition, with a maximum mobilised volume of 68,657.14 m³, notably lower than during construction (see **Chapter 9 Fish (including Basking Shark) and Shellfish**). These events are localised, temporary, and do not meaningfully affect fish, shellfish, spawning or nursery grounds, or the prey availability of marine

mammals and leatherback turtles. Accordingly, the magnitude of impact from SSCs and redeposition is assessed as negligible for all receptors in relation to prey availability.

399. The introduction of hard substrate within the WDA will primarily arise from the installation of foundations and scour protection during construction, with the most evident ecological changes occurring during the O&M phase. The total area of hard substrate introduced is estimated at 6,788,230.51 m², representing approximately 1.52% of the WDA, and is therefore highly localised in the context of both the WDA and the wider Regional Study Area. As the spatial extent of these features is small, any resulting changes to habitat availability will be minor and restricted to areas immediately surrounding the structures. Consequently, the magnitude of impact associated with the introduction of hard substrate is assessed as negligible for all receptors, and thus the effect on prey availability for marine mammals and leatherback turtles is also considered negligible.

400. Operational underwater noise from WTGs is low intensity, dominated by low-frequency tones, and remains well below thresholds for injury or TTS. Any behavioural responses are expected to be minor and confined to only a few metres around individual WTGs (see **Chapter 9 Fish (including Basking Shark) and Shellfish**). Intermittent noise from O&M vessels is short-lived and reversible and does not alter the overall noise environment. As such, the magnitude of underwater noise impacts is considered negligible, resulting in a negligible magnitude for all receptors due to changes in prey availability from operational noise.

401. The risk of introducing INNS over the full operational lifetime is expected to remain low, as O&M vessels will continue to be subject to the embedded biosecurity measures set out in **Appendix 8 Invasive Non-Native Species Mitigation Plan**. On this basis, the magnitude of impact on fish and shellfish receptors has been assessed as negligible. Consequently, prey-mediated effects on marine mammals and leatherback turtle, arising indirectly from potential changes in prey availability, are also assessed as negligible magnitude, with no significant effects on prey resources anticipated.

402. As outlined in **Chapter 9 Fish (including Basking Shark) and Shellfish**, fishing activity is expected to continue throughout the WDA during operation, with only small, short-duration exclusion areas associated with occasional maintenance. While some voluntary avoidance may occur near WTGs or cables, this is minor, and static gear fleets can readily adapt to operate safely around infrastructure. Spawning and nursery grounds, diadromous species, and key shellfish stocks are not expected to be affected, and no pathway exists for increased pressure on sensitive species such as basking shark. Therefore, changes to fishing activity and resulting effects on prey availability result in negligible impacts for marine mammals and leatherback turtles.

403. No project-specific EMF modelling has been undertaken; however, evidence from comparable SEP/DEP and Green Volt assessments indicates that EMF emissions from subsea power cables are highly localised and rapidly attenuate with distance. The Project's Inter-array cables (up to 132 kV AC), OSP link cables (up to 400 kV AC), and HVDC export cables (up to 525 kV) all exhibit magnetic fields that decrease to <1 µT within approximately 5 m of the seabed, aided by cable burial and cable armouring. Effects on electrosensitive species are limited to short-term behavioural responses within a few metres of cables, with no evidence of migration disruption or population-level consequences (see **Chapter 9 Fish (including Basking Shark) and Shellfish**). EMF-related impacts on prey availability for marine mammals and leatherback turtles is assessed as negligible.

10.12.1.12.2.3 Decommissioning

404. The potential effects on prey species for marine mammals and leatherback turtle during the decommissioning phase have been considered in **Chapter 9 Fish (including Basking Shark) and Shellfish.** The assessment concludes that all impacts to fish, shellfish, nursey grounds and spawning grounds would be similar or less than the construction phase.

405. Details regarding the magnitudes of effects of prey availability for all receptors would be the same as the construction phase, which is negligible to low (see **Section 10.12.1.12.2.1**).

10.12.1.12.3 Significance of Effect

406. During the construction phase, taking the worst-case magnitude of impact on prey availability (from underwater noise and vibration), harbour porpoise, minke whale, humpback whale and fin whale are assigned **medium** sensitivity (**Table 10.14**), the magnitude is assessed as **low**, resulting in **minor adverse** effect, which is **not significant** in EIA terms. For all delphinids, pinnipeds and leatherback turtle, the sensitivity is assessed as **low**, and the magnitude is **low**, resulting in **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.60**).

407. During the O&M phase, the magnitude is assessed as **negligible** for all receptors, resulting in **negligible adverse** effect, which is **not significant** in EIA terms.

10.12.1.12.3.1 Designated Sites

408. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be indirectly affected by changes to prey availability due to activities in the WDA. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted from changes to prey availability (**Table 10.60**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

409. For minke whale, activities within the WDA are unlikely to result in changes to prey availability within the relevant designated site, the Sea of the Hebrides NCMPA, as prey-mediated pathways were screened out of the NCMPA-specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment**. Therefore, any changes to prey resources within the WDA are not anticipated to result in significant effects on the NCMPA.

410. For pinnipeds, several designated sites may be affected indirectly by changes to prey availability due to activities in the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites due to changes in prey availability (**Table 10.55**).

Table 10.60 Assessment of significance of effect for the potential of an indirect effect to marine mammals through changes to prey resources

Impact	Marine receptor species group	Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Effect
Construction and Decommissioning						
Physical disturbance and temporary habitat loss	Harbour porpoise	Medium	Negligible (negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds*	Low				
	Leatherback turtle					
Increased suspended sediments and sediment deposition	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Underwater noise and vibration	Harbour porpoise	Medium	Low	Minor adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Invasive non-native species	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				

Impact	Marine receptor species group	Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Effect
	Leatherback turtle					
Change in fishing activity	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
O&M						
Long-term habitat loss	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Increased SSCs	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Introduction of hard substrate	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				

Impact	Marine receptor species group	Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Effect
	Pinnipeds	Low				
	Leatherback turtle					
Underwater noise	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Invasive non-native species	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
Changes in Fishing	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				
	Pinnipeds	Low				
	Leatherback turtle					
EMF	Harbour porpoise	Medium	Negligible	Negligible adverse	N/A	Not significant
	Delphinids	Low				
	Mysticetes	Medium				

Impact	Marine receptor species group	Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Effect
	Pinnipeds	Low				
	Leatherback turtle					

10.12.1.13 Impact 11: Underwater noise from operating WTG

411. Currently available data indicates that there is no lasting disturbance or exclusion of harbour porpoise or seals around windfarm sites during operation (Diederichs et al. 2008a; Lindeboom et al. 2011; Marine Scotland 2012; McConnell et al. 2012; Russell et al. 2014a; Scheidat et al. 2011; Teilmann et al. 2006a; Tougaard et al. 2005a, 2009a, 2009b). Data collected suggests that any behavioural responses for harbour porpoise and seal may only occur up to a few hundred metres away (Touggard et al. 2009b; McConnell et al. 2012).

10.12.1.13.1 Sensitivity

412. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.12.1.13.2 Magnitude of Impact

413. Impacts would only occur during the O&M phase.

10.12.1.13.2.1 Auditory Injury

414. The number of marine mammals that could be impacted as a result of underwater noise from operational WTGs has been assessed based on the number of animals that could be present in the modelled impact area (see **Table 10.61**).

415. **Appendix 10.1 Underwater Noise Modelling Report** indicates that the predicted impact range for all receptors is less than 50 m (0.01 km^2). This indicates that auditory injury is not expected to occur, as the hearing threshold is non-exceedance.

416. Although there is unlikely to be any significant risk of any auditory injury, as the modelling indicates that any receptor would have to be within less than 50 m from a WTG for a prolonged amount of time (24-hours), in order for TTS to occur. However, as a precautionary approach, the number of receptors that could be at risk of TTS has been assessed for underwater noise from a single WTG (**Table 10.61**).

417. Only a single WTG has been assessed, because the spacing between the WTGs in the WDA is at least 944 m and therefore there is no spatial overlap for any auditory injury from multiple operating WTG.

418. The magnitude of the potential impact for any TTS as a result of underwater noise from one operational WTG is **negligible** for all receptors, with less than 0.001% of the reference populations exposed to any long-term impacts (**Table 10.61**).

Table 10.61 Maximum number of individuals (and % of reference population) that could be at risk of TTS as a result of underwater noise associated with operational WTGs

Species	Maximum number of individuals (% of reference population) for one WTG	Magnitude of impact (temporary)
Harbour porpoise	<1 (0.00003% WS MU)	Negligible
Bottlenose dolphin	<1 (0.001% CWSH MU & 0.00003% OW MU)	Negligible (CSWH MU & OW MU)
Common dolphin	<1 (0.00001% CGNS MU)	Negligible
Atlantic white-sided dolphin	<1 (0.000002% CGNS MU)	Negligible

Species	Maximum number of individuals (% of reference population) for one WTG	Magnitude of impact (temporary)
White-beaked dolphin	<1 (0.00001% CGNS MU)	Negligible
Risso' dolphin	<1 (0.000001% CGNS MU)	Negligible
Killer whale	<1 (0.0001% WCC & 0.0000001% NA)	Negligible (WCC & NA)
Long-finned pilot whale	<1 (0.0000002% CGNS MU)	Negligible
Minke whale	<1(0.00002% CGNS MU)	Negligible
Fin whale	<1 (0.0000006% NA)	Negligible
Humpback whale	N/A	Negligible
Grey seal*	<1 (0.0001% WS MU & 0.00002% Wider MU)	Negligible (negligible)
Harbour seal*	<1 (0.000004% WS MU & 0.000002% Wider MU)	Negligible (negligible)
Leatherback turtle	N/A	Negligible
**Magnitudes given in brackets are for the wider reference populations used for the assessment*		

10.12.1.13.2.2 Disturbance

419. Recent research indicates that operational windfarms do not cause long-term displacement of marine mammals (Diederichs et al., 2008a; Lindeboom et al., 2011; Marine Scotland, 2012; McConnell et al., 2012; Russell et al., 2014a; Scheidat et al., 2011; Teilmann et al., 2006a; Tougaard et al., 2005a, 2009a, 2009b). Studies across the North Sea and other European waters have shown that marine mammals continue to use windfarm areas during operation, with evidence of stable or increased abundance rather than permanent avoidance. Using PAM to monitor marine mammal presence in operating offshore windfarms in Belgian waters revealed that harbour porpoise are foraging within them, likely attracted by artificial reef structures around WTG foundations, which can enhance prey availability (Aoufi et al., 2023). Similarly, observations from multiple North Sea offshore windfarms suggest that porpoises are present year-round, with peaks in winter and autumn, indicating no persistent exclusion (Leemans & Fijn, 2023). For larger cetaceans, such as minke whales and other mysticetes, available data remain limited; however, sightings near operational WTG in Scottish waters, including the European Offshore Wind Deployment Centre Offshore windfarm, show no evidence of avoidance. In fact, feeding behaviour has been recorded in close proximity to WTGs, once again suggesting that prey availability may increase due to the artificial reef effect created by WTG foundations (Marine Scotland, 2012; Fernandez et al., 2022).

420. Pinnipeds have shown similar behaviours, with studies recording seals foraging within the operational windfarm areas in Germany and in the UK. This further suggests that WTG structures could provide feeding opportunities rather than act as movement barriers (Russell et al., 2014a). These findings align with previous studies at Nysted and Rødsand, where seal populations remained stable throughout the operational phase, with no evidence of displacement (Teilmann et al., 2006a). More recent studies highlight that both harbour and grey seals adapt quickly to operational conditions, with movement patterns unaffected by WTG presence (Courbis et al., 2023). Noise modelling supports these observations, predicting that operational WTG noise is unlikely to cause significant displacement or disturbance of marine mammals. Operational noise levels are considered too low to pose a risk of auditory injury or sustained avoidance, with any behavioural responses expected to be highly localised and temporary. Modelling of noise effects from operational offshore WTGs suggests that marine mammals are not considered at risk of displacement during the operational phase (Marmo et al., 2013). Any disturbance within the potential impact area is expected

to be short-term, with animals returning once the disturbance ceases or they become habituated to the sound.

421. Based on the review of marine mammals and operational windfarms, the noise levels associated with operational WTGs, and the duration of the operational life of the Project, a precautionary magnitude of impact of **low** has been assigned to all receptors.

10.12.1.13.3 Significance of Effect

422. Based on a **medium** sensitivity of all receptors for TTS and a magnitude for TTS to occur from a single operating WTG of **negligible** for all receptors, a **negligible adverse** effect is predicted which is **not significant** in EIA terms (**Table 10.62**).

423. For the potential for disturbance, due to operational WTG, the sensitivity has been assigned as **low** for all receptors. The magnitude is assessed as **low** resulting in **minor adverse** effect, which is **not significant** in EIA terms for all receptors (**Table 10.62**).

10.12.1.13.3.1 Designated Sites

424. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by underwater noise due to operating WTG in the WDA. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIA. As no significant effects on the WS MU are predicted from underwater noise due to operating WTG in the WDA (**Table 10.62**), no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

425. For minke whale, operating noise from the WTG within the WDA are unlikely to result in any effects to the designated site, the Sea of the Hebrides NCMPA, as underwater noise from operating WTGs was screened out of the NCMPA-specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment**. Therefore, any noise from operating WTG in the WDA are not anticipated to result in significant effects on the NCMPA.

426. For pinnipeds, several designated sites may be affected by underwater noise due to operating WTG in the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIA. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites due to underwater noise from operating WTG in the WDA (**Table 10.62**).

Table 10.62 Assessment of significance of effect from underwater noise from operating WTGs

Impact	Receptor	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Effect
Auditory Injury / TTS	Harbour porpoise, common dolphin, Atlantic white-sided, dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale	Medium	Negligible	Negligible adverse	N/A	Not significant
	Bottlenose dolphin		Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Negligible (negligible)	Negligible adverse (negligible adverse)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant
Disturbance	Harbour porpoise, common dolphin, Atlantic white-sided, dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale & humpback whale	Low	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Killer whale		Low (WCC & NA)	Minor adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Grey seal & harbour seal*		Low (low)	Minor adverse (minor adverse)	N/A	Not significant
	Leatherback turtle		Low	Minor adverse	N/A	Not significant
** Magnitudes and significant effects in brackets are for the wider reference populations used in the assessment*						

10.12.2 Combined Assessment: Windfarm Development Area, Offshore Export Cable Corridor and Onshore Development Transmission Development Area

427. The impacts for the WDA presented in **Section 10.12.1** are likely to have interactions and additive effects with activities occurring in the Offshore ECC. However, there will be no interactions and additive effects between the WDA and the OnTDA, therefore this section will just focus on the combined effects of the WDA and the Offshore ECC.

10.12.2.1 Impact 1: Underwater noise during geophysical surveys

428. Potential effects from underwater noise from geophysical surveys is assessed in **Section 10.12.1.3**.

429. Geophysical surveys may be undertaken within the Offshore ECC at the same or similar time as the WDA. There is therefore potential for underwater noise throughout the WDA and Offshore ECC during geophysical surveys.

430. Potential effects in the WDA have been assessed in **Section 10.12.1.3**. For auditory injury (PTS) and disturbance for a maximum of up to three vessels have been assessed for the Project as a worst-case. It is not anticipated that more than three geophysical survey vessels would be operating throughout the WDA and Offshore ECC, therefore the assessment presented in **Section 10.12.1.3** is a good representation of the level of impact that would occur within Offshore ECC. The only exception would be that the marine mammal densities would be re-calculated for the finalised Offshore ECC boundary and a quantified assessment provided, although it should be noted that the densities for all marine mammals within the ECC would be the same or lower than for the WDA, with the exception of both seal species, which are likely to be higher due to the more coastal nature of the ECC compared to the WDA.

431. Therefore, the combined assessment of effects on receptors and designated sites remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.2 Impact 2: Underwater noise during UXO clearance

432. Underwater noise during UXO clearance for the WDA-alone is assessed in **Section 10.12.1.4**.

433. The WDA-alone assessment concluded that there would be no significant effect on marine mammals and leatherback turtle.

434. A marine licence for UXO clearance for the WDA and Offshore ECC will be submitted post-consent when accurate information on the number and location of UXO devices is available.

435. Based on the indicative assessment for the WDA-alone, it is not anticipated that there would be any significant additive effects from UXO clearance however this will be assessed as part of the separate marine licence application post-consent.

436. Potential interactions and additive effects between the WDA and the Offshore ECC from UXO clearance will be assessed for auditory injury (PTS/TTS) and disturbance for all receptors from a single low-order UXO clearance and a high order UXO clearance for the Offshore ECC which is anticipated to be very similar to that presented for the WDA-alone however marine mammal densities will be recalculated based on the final Offshore ECC.

437. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.3 Impact 3: Auditory injury from underwater noise during piling

438. There will be no piling in the Offshore EEC, therefore there will be no interactions and additive effects between the WDA and the Offshore ECC.

10.12.2.4 Impact 4: Disturbance and behavioural impacts from underwater noise during piling

439. There will be no piling in the Offshore EEC, therefore there will be no interactions and additive effects between the WDA and the Offshore ECC.

10.12.2.5 Impact 5: Auditory injury and behavioural impacts resulting from noise associated with non-piling activities

440. Auditory injury and behavioural response from non-piling activities is assessed for the WDA alone in **Section 10.12.1.7**. Works between the WDA and Offshore ECC are unlikely to occur at the same time as each phase would likely be programmed to be undertaken separately.

441. For auditory injury, the worst-case impact range is 6 km for harbour porpoise for any rock placement activity, which is highly precautionary as for auditory injury to occur in a single harbour porpoise, the animal would need to be within the predicted impact range for at least 24-hours which is highly unlikely. The WDA-alone assessment concluded that there would be no significant effects on marine mammals and leatherback turtle, from a single activity or multiple activities occurring at the same time within the WDA for both auditory injury and disturbance.

442. Potential interactions and additive effects between the WDA and the Offshore ECC from non-piling activities will be assessed for auditory injury and disturbance for all receptors. However, it is considered that there is very low potential for additive auditory injury effects from non-piling activities occurring in the WDA and Offshore ECC except, potentially, if activities were to occur within the Offshore ECC within 6 km of the WDA assuming activities are undertaken at the same time. There is no significant effect for the WDA-alone and the impact magnitudes in the Offshore ECC would be the same or very similar to those for the WDA-alone. Further details will be included within the Offshore ECC EIA.

443. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.6 Impact 6: Auditory injury and behavioural response from vessel noise

444. Auditory injury and behavioural response from vessel noise is assessed for the WDA-alone in **Section 10.12.1.8**.

445. For auditory injury to occur, as a worst-case for harbour porpoise, an individual would have to be within 1.5 km of a medium-sized vessel for 24-hours. It is highly unlikely that an individual animal would remain this close for that period of time and therefore it is considered that there is very low potential for additive auditory injury effects from vessels operating in the WDA and Offshore ECC.

446. Regarding behavioural effects, the WDA-alone assessment concluded that the significance of effect was negligible or minor adverse for all receptors. Whilst the number of vessels required for the Offshore ECC will not be confirmed until preparation of the Offshore ECC EIA, it is anticipated that the requirement would be much lower than for the WDA. Moreover, as the behavioural disturbance range from vessels is 4 km, there would only be potential for additive effects where vessels are operating within 4 km of the WDA and only in the case that there is a temporal overlap of vessel activity within the Offshore ECC and WDA.

447. Further details will be included within the Offshore ECC EIA however it is not anticipated that behavioural response impacts from vessel noise would be significant.

448. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.7 Impact 7: Barrier effects due to underwater noise

449. Barrier effects due to underwater noise is assessed for the WDA-alone in **Section 10.12.1.9**. The WDA-alone assessment concluded a significance of effect of minor adverse for all receptors.

450. Potential interactions and additive effects between the WDA and the Offshore ECC from barrier effects due to underwater noise for example from UXO could theoretically occur however it is highly unlikely that separate UXO clearance campaigns would be undertaken simultaneously in the WDA and Offshore ECC and that any noise impact ranges would occur at the same time or overlap in such a way as to cause a barrier effect. During the construction phase, it is not anticipated that there would be any piling within the Offshore ECC. As a result, any barrier effects are expected to be confined to the WDA.

451. Further details will be included within the Offshore ECC EIAR however it is not anticipated that behavioural response impacts from vessel noise would be significant, as the number of vessels in the ECC is likely to be less compared to the WDA, there will be no piling and the noise generating activities are likely to be temporally and spatially distinct.

452. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.8 Impact 8: Vessel interaction (collision risk)

453. Vessel collision risk is assessed for the WDA-alone in **Section 10.12.1.10**.

454. For vessel interaction and collision risk, the WDA-alone assessment concluded that the significance of effect was minor adverse for all receptors.

455. Potential interactions and additive effects between the WDA and the Offshore ECC from vessel collision could occur however, because the number of vessels required for Offshore ECC infrastructure installation will be less than for the WDA and the activities will largely be temporally and geographically distinct it is not anticipated that vessel collision from an increase in vessel activity would be significant.

456. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.9 Impact 9: Disturbance at Protected Seal Haul-Out Sites

457. Disturbance at protected seal haul-out sites is assessed for the WDA-alone in **Section 10.12.1.11**.

458. Regarding disturbance at protected seal haul-out sites from piling, the WDA-alone assessment concluded that the significance of effect was minor adverse.

459. There will be no piling in the Offshore EEC, therefore there will be no interactions and additive effects between the WDA and the Offshore ECC from piling.

460. Considering disturbance at protected seal haul-out sites from vessels transiting to and from the WDA, **Figure 10.6** and **Figure 10.7** and the corresponding assessment conclusion which states the significance of effect is minor adverse in the WDA-alone assessment. Given that the number of

vessels operating in the Offshore ECC is anticipated to be much lower than the WDA, and is likely to follow a similar transit to port, significant additive or interactional effects are not anticipated.

461. Further details will be included within the Offshore ECC EIA however it is not anticipated that vessels transiting from indicative ports to the Offshore ECC would be significant.

462. Therefore, the combined assessment of effects on receptors remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.10 Impact 10: Changes to Prey Availability

463. Indirect effects to marine mammals and leatherback turtles via changes to prey availability has been assessed for the WDA-alone in **Section 10.12.1.12**.

464. Potential interactions and additive effects between the WDA and the Offshore ECC from non-piling activities will be assessed in relation to changes in prey availability for all receptors. However, the potential for any additive effects on prey resources arising from non-piling activities within the WDA and Offshore ECC is considered to be very low. As there is no significant effect for the WDA alone, based on the information available at this stage, the assessment assumes that the impact magnitudes within the Offshore ECC would be the same as, or less than the WDA alone, no additional effects are anticipated. Further detail will be presented within the Offshore ECC EIA.

465. Therefore, the combined assessment of effects on receptors and designated sites remains **minor adverse**, which is **not significant** in EIA terms, consistent with the WDA-alone assessment.

10.12.2.11 Impact 11: Underwater Noise from Operating WTG

466. There will be no WTG in the Offshore EEC, therefore there will be no interactions and additive effects between the WDA and the Offshore ECC.

10.12.2.12 Combined Assessment Summary

467. Overall, taking account of the spatial extent of the combined assessment area encompassing the WDA and Offshore ECC, the short duration of noisy activities and vessel presence, the confinement of effects largely to the WDA with substantially fewer effects within the ECC, and the implementation of embedded mitigation, any combined effects across all project phases are predicted to be minor adverse and **not significant** in EIA terms.

Table 10.63 Marine mammals and leatherback turtle combined assessment summary

Receptor/Topic	WDA Residual Effect	Offshore ECC Assessment of Effects	OnTDA Assessment of Effects	Combined Assessment
C* Impact 1: Underwater noise during geophysical surveys	Not Significant (Minor to Negligible Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.1** Not Significant (Minor Adverse).
C* Impact 2: Underwater noise during UXO clearance	Not Significant (Minor to Negligible Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.2** Not Significant (Minor Adverse).
C* Impact 3: Auditory injury from underwater noise during piling	Not Significant (Minor to Negligible Adverse).	N/A	N/A – no pathway to receptors.	Not Significant (Minor to Negligible Adverse).

Receptor/Topic	WDA Residual Effect	Offshore ECC Assessment of Effects	OnTDA Assessment of Effects	Combined Assessment
C* Impact 4: Behavioural impacts from underwater noise during piling	Significant (Minor to Negligible Adverse).	N/A	N/A – no pathway to receptors.	Not Significant (Minor to Negligible Adverse).
C; O&M; D* Impact 5: Auditory injury and behavioural impacts resulting from noise associated with other construction activities (such as dredging and rock placement).	Not Significant (Minor to Negligible Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.5** Not Significant (Minor Adverse).
C; O&M; D* Impact 6: Auditory injury and disturbance resulting from the presence of vessels	Not Significant (Minor to Negligible Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.1.13** Not Significant (Minor Adverse).
C; O&M; D* Impact 7: Barrier effects from underwater noise	Not Significant (Minor Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.7** Not Significant (Minor Adverse).
C; O&M; D* Impact 8: Vessel interaction (collision risk)	Not Significant (Minor Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.8** Not Significant (Minor Adverse).
C; O&M; D* Impact 9: Disturbance at seal haul-out sites	Not Significant (Minor Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.2.9** Not Significant (Minor Adverse).
C; O&M; D* Impact 10: Changes to prey resources	Not Significant (Minor Adverse).	Not Significant (Minor Adverse).	N/A – no pathway to receptors.	See **Section 10.12.1.12** Not Significant (Minor Adverse).
O&M* Impact 11: Underwater noise from operating WTG	Not Significant (Negligible Adverse).	N/A	N/A – no pathway to receptors.	N/A
* C = Construction, O&M = Operation and Maintenance, D = Decommissioning				

10.13 CUMULATIVE EFFECTS

468. To support the CEA, the potential for cumulative effects has been established considering each WDA-alone effect and the impact area alongside the list of plans, projects and activities that could potentially interact. The full methodology and stages of this process are presented in **Appendix 10.5 CEA Screening**.

10.13.1 Screening of Potential Cumulative Impacts

469. As part of the CEA, each individual impact identified for the Project was reviewed to determine whether it could contribute to a cumulative effect on relevant receptors. This initial screening stage

is summarised in **Table 10.64**. Those impacts that were assessed as having a significance of negligible or greater in the Project-alone assessment were carried forward into the CEA. Impacts assessed as no change were excluded, as they have no realistic potential to add to cumulative effects.

470. Further detail on the CEA project screening process is provided in **Appendix 10.5 CEA Screening**. This appendix also describes the types of activities and industry sectors that may give rise to cumulative effects during both construction and O&M phases. The assessment considered the following potential impact pathways:

- Cumulative disturbance from underwater noise, including contributions from:
  - Piling at other offshore windfarms, port developments;
  - Non-piling construction activities at other offshore windfarms;
  - O&M activities at other offshore windfarms;
  - Other substructure installation activities (excluding impact piling);
  - Geophysical survey activities;
  - Seismic surveys; and
  - UXO clearance.
- Vessel disturbance and collision risk;
- Barrier Effects due to underwater noise;
- Disturbance to protected haul out sites; and
- Changes in prey availability

471. The magnitude of impact from each activity is assessed individually, followed by an overall determination of significance.

Table 10.64 Summary of potential cumulative effects (impact screening)

Impact	Project-Alone Residual Effects Significance	Potential for Cumulative Effects	Rationale
Auditory Injury and Behavioural Impacts of Underwater Noise Impacts from Piling at Other Offshore Windfarms	Not Significant (Minor adverse)	Yes	PTS can occur during pile-driving activities associated with offshore windfarm installation. Where there is any potential for PTS from pile driving, suitable mitigation would be required to reduce any risk to marine mammals. Disturbance may also occur, resulting in short-term behavioural changes that typically resolve within hours to days after noise exposure ends. Disturbance generally has greater effect ranges and areas than modelled PTS, but the effects are temporary. Therefore, the potential for disturbance to marine mammals from noise associated with pile driving has been screened in.
Underwater Noise from non-piling Activities at other Offshore Windfarms	Not Significant (Minor adverse)	Yes	Non-piling construction activities such as dredging, drilling, rock placement, vessel movements, and noise generated by operational offshore windfarms tend to produce broadband noise at lower frequencies. Any PTS from these sources is expected to be highly localised, and cumulative effects are unlikely. Disturbance to marine mammals may occur over broader areas, but such effects are short-term and resolve shortly after noise exposure ends. Disturbance from these non-piling activities has been screened in.
Underwater noise from operational WTG at Other Offshore Windfarms	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects and therefore the potential for an increase in operating WTG noise at other offshore windfarms has been screened in.
Underwater Noise from Other Industries and Activities	Not Significant (Negligible adverse)	Yes	PTS may also occur during the use of underwater noise from seismic and geophysical surveys, port constructions, cable installation and explosives, which are occasionally required during the removal of subsea structures or UXO clearance. Any PTS from these noisy activities is expected to be highly localised, and cumulative effects are unlikely. However, disturbance effects from these activities may occur over wider areas but remain temporary, typically resolving within hours to days after exposure, and have therefore also been screened in.
Underwater Noise and Presence of Vessels	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects and therefore the potential for an increase in vessel collision risk has been screened in.
Barrier effects due to underwater noise	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects and therefore the potential for an increase in barrier effects due to underwater noise has been screened in.

Impact	Project-Alone Residual Effects Significance	Potential for Cumulative Effects	Rationale
Disturbance at Seal Haul-out Sites	Not significant (Negligible to Minor adverse)	Yes	As described in **Appendix 10.5 CEA Screening**, no significant impacts with regards to disturbance at seal haul-out sites is expected for the Project. Any disturbance at seal haul out sites as a result of other projects would be localised and temporary. However, given the minor adverse significance conclusion this has been screened in.
Changes to Prey Availability	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects on changes to prey resources and therefore it has been screened in.

10.13.2 Screening of Other Plans, Projects and Activities

472. The cumulative effects screening considered all noise-generating activities including piling at other offshore windfarms, non-piling construction and O&M noise, O&M noise, geophysical surveys, cable-laying, explosives and associated vessel activity. If any of these occur at the same time as construction activities at the Project, there is potential for cumulative effects.

473. Impact piling during construction represents the worst-case underwater noise source associated with the Project and therefore provides a conservative basis for the CEA across all phases. As a result, detailed cumulative assessment is focused only on piling at the Project, with other activities at the Project included as contextual noise sources.

474. Any cumulative underwater noise effects arising during the O&M or decommissioning phase of the Project would be substantially lower in magnitude and spatial extent than those associated with piling during construction. Therefore, any cumulative effects that would occur during O&M and decommissioning of the Project, would be no greater than those assessed for the construction phase worst-case scenario. On this basis, separate cumulative assessment of O&M and decommissioning noise is not provided.

475. Screening of other plans and projects was undertaken was limited to those located within the relevant receptor MUs (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**). **Appendix 10.5 CEA Screening** provides the full list of activities considered, the screening rationale, and the detailed outcomes.

476. A refined shortlist of plans and projects with potential to contribute to cumulative effects on receptors is presented in **Table 10.65**. Tier 1 projects comprise those that are operational (but not part of the baseline), under construction, consented, or with applications submitted. Tier 2 projects include those at an early planning stage where scoping reports have been submitted. Tier 3 projects are those with an option to lease but with no scoping report submitted; these have therefore been screened out of the CEA due to the lack of detailed information, but are listed for completeness in **Appendix 10.5 CEA Screening.** Each noisy activity was considered individually, with only those showing a potential to result in cumulative effects being taken forward to detailed assessment.

477. Screening decisions were based on the following criteria:

- Existence of a potential pathway for cumulative effects.
- Spatial overlap of impacts between the Project and the other activity.
- Temporal overlap of impacts.
- Availability of sufficient and reliable information (such as scoping/EIARs).
- Likelihood that residual effects, after mitigation, could contribute to significant cumulative effects.

478. In total, 20 plans and projects (18 windfarms and two subsea cables) were identified where potential cumulative effects with piling at the Project could occur (**Table 10.65**). These are assessed in detail in **Sections 10.13.3.1.1** and **10.13.3.1.3**.

Table 10.65 Short list of plans/projects screened in for marine mammal CEA

Project / Plan	Development Type	Status	Tier	Construction Period	Operational	Closest Distance to MachairWind (km)	Rationale
Arklow Bank - Phase 2	Offshore windfarm	Consent application submitted	1	2027-2030	2030	330 km	Potential temporal overlap of non-piling and O&M activities
Awel y Mor	Offshore windfarm	Consent Authorised	1	2029-2030	2030	328 km	Potential temporal overlap of piling activities
Codling	Offshore windfarm	Consent application submitted	1	2027-2030	2030	306 km	Potential temporal overlap of O&M activities
Dublin Array	Offshore windfarm	Consent application submitted	1	2027-2030	2030	300 km	Potential temporal overlap of piling activities
Havbredey	Offshore windfarm	Scoping/Early Planning	2	2032-2036	2036	301 km	Potential temporal overlap of piling activities
LirIC Connector	Subsea Cable	Scoping/Early Planning	2	N/A	2032	125 km	Potential spatial and temporal overlap of construction activities (MachairWind Offshore ECC)
Malin Sea Wind	Offshore windfarm	Scoping/Early Planning	2	2029-2031	2031	41 km	Potential for spatial and temporal overlap of piling activities
Mona	Offshore windfarm	Consent Authorised	1	N/A	2029	249 km	Potential temporal overlap of non-piling and O&M activities
Mooir Vannin	Offshore windfarm	Consent Application submitted	1	2032-2033	2033	244 km	Potential temporal overlap of piling activities
Morecambe	Offshore windfarm	Consent Authorised	1	2027-2029	2029-2030	304 km	Potential temporal overlap of O&M activities
Morgan	Offshore windfarm	Consent Authorised	1	2026-2028	2029	290 km	Potential temporal overlap of O&M activities

Project / Plan	Development Type	Status	Tier	Construction Period	Operational	Closest Distance to MachairWind (km)	Rationale
North Channel Wind 1	Offshore windfarm	Scoping/Early Planning	2	2029-2031	2031	100 km	Potential temporal overlap of non-piling construction activities
North Channel Wind 2	Offshore windfarm	Scoping/Early Planning	2	2029-2031	2031	142 km	Potential temporal overlap of non-piling construction activities
Northern Irish Sea Array	Offshore windfarm	Consent application submitted	2	2027-2029	2029	244 km	Potential temporal overlap of piling activities
Oriel Offshore Windfarm	Offshore windfarm	Consent Authorised	2	2026-2028	2028	218 km	Potential temporal overlap of O&M activities
Pentland Floating Offshore windfarm	Offshore windfarm	Consent Authorised	1	2024-2024	2026	342 km	Potential temporal overlap of O&M activities
Spiorad na Mara	Offshore windfarm	Scoping/Early Planning[14]	2	2028-2031	2031	244 km	Potential temporal overlap of piling activities
West of Orkney	Offshore windfarm	Consent Authorised	1	2027-2029	2029/2030	330 km	Potential temporal overlap of O&M activities
Western Link 2	Subsea Cable	Pre-application	2	N/A	N/A	160 km	Potential for spatial and temporal overlap of construction activities (MachairWind Offshore ECC)
Western Star	Offshore windfarm	Scoping/Early Planning	2	N/A	2030/2032	N/A	Potential for temporal overlap of piling activities

[14]While this project submitted its consent application in February 2026, it was outside of the Project's agreed cut-off date (of six months prior to submission) and therefore has not been incorporated into the assessments. However, all assessments are undertaken on a precautionary basis and it is not expected that its inclusion would alter the overall conclusions of the cumulative assessment.

10.13.3 Cumulative Effects Assessment

479. Following identification of the residual effects from the Project with potential to contribute to cumulative impacts alongside the relevant external plans, projects, and activities, the scale and nature of any resultant cumulative effects is assessed. These assessments are presented for each impact pathway where cumulative effects have been identified, consistent with **Table 10.64**.

480. Using the potential impacts listed in **Table 10.64** and the plans and projects identified as having the potential to contribute to cumulative effects (see **Appendix 10.5 CEA Screening**), a detailed cumulative assessment was carried out where necessary. This assessment incorporates all relevant information from the MachairWind Project and the other screened in projects.

481. During the EIA processes for some of the screened projects, assessment information has been updated or refined over time. Any post application submission updates to third-party project assessments are not considered to alter the overall conclusions of these cumulative effects assessments.

482. The quantitative assessments that follow present estimates of the number of animals predicted to be affected or disturbed at a single point in time. However, the magnitude of impact also takes the duration of effects into account. For disturbance effects in particular, it should be recognised that animals within the modelled disturbance zones are unlikely to respond uniformly. Some individuals may move away from the area, while others may remain and experience disturbance again from additional or overlapping noise sources within the wider MU.

483. Accurate assessments of repeated disturbance events over extended time periods are currently not available due to limitations in this type of assessment. In the absence of such data, a precautionary qualitative approach has been used to consider the potential cumulative implications of recurring disturbance. It is also recognised that noisy activities are not expected to occur continuously or simultaneously; rather, they are likely to occur intermittently throughout the construction and operational phases of the MachairWind Project, with the potential for overlap and repeated disturbances across its lifetime. These potential interactions and additive effects across multiple disturbance pathways are discussed further in **Section 10.15.2**.

10.13.3.1 Cumulative Effect 1: Auditory Injury and Behavioural Impacts from Underwater Noise

484. Auditory injury and disturbance from underwater noise are assessed as effects for the impact pathways described below.:

- Underwater noise during piling;
- Underwater noise during non-piling activities (construction, O&M and decommissioning activities) at other offshore windfarms; and
- Underwater noise from other industries and activities.

10.13.3.1.1 CE1a: Auditory Injury and Behavioural Impacts of Underwater Noise Impacts from Piling at Other Offshore Windfarms

485. Following the initial screening of UK, IoM and RoI offshore windfarms, a further stage of screening was undertaken to identify those projects with construction schedules that may overlap with the MachairWind Project. This review considered known or anticipated construction periods, including piling windows and key construction activities, to derive a realistic, and precautionary, list of UK, IoM and RoI offshore windfarms with the potential for piling overlap with the MachairWind Project. Further detail on this screening is provided in **Appendix 10.5 CEA Screening**.

486. All marine mammal species and leatherback turtles are considered to have high sensitivity to auditory injury from underwater noise. However, the potential for cumulative PTS from piling at other offshore windfarms has not been quantitively assessed further as all consented/licenced projects are required to implement mitigation measures that should ensure any PTS effects remain negligible. For receptors where population modelling was undertaken, PTS effects were incorporated into the modelling and were predicted to result in no significant population-level effects.

487. In addition, PTS effects are expected to be highly localised around each individual project based on the modelled impact ranges. The cumulative magnitude of PTS risk to marine mammals and leatherback turtle from multiple underwater noise sources was assessed as negligible. This conclusion reflects the very small spatial extent of PTS ranges, the substantial distances between offshore windfarms and other noisy activities, and the consistent application of mitigation commitments complying with latest guidance and policies across all projects.

488. Potential disturbance arising from underwater noise during piling has been assessed using the JNCC (2025b) EDRs used for the Project-alone assessment, as Thompson et al. (2025) demonstrated that the use of DRC assessments is likely to be overly precautionary, and that distance-based response functions provide a more realistic representation of disturbance, which is more representative of EDRs. (see **Section 10.12.1.6**).

489. Of the 18 UK, IoM and RoI offshore windfarms identified as having construction periods that could overlap with the MachairWind Project, ten projects may undertake piling during the same period (**Table 10.66**). Floating offshore windfarms such as North Channel Wind 1 and 2 and Malin Sea Wind could result in cumulative underwater noise from piling of pin-piles which has been assessed as a worst-case. Dublin Array and Western Star windfarms have been screened in for seal wider MUs and have been screened out of the CEA for cetaceans, as the assessment is limited to the UK portion of the population range.

490. As noted in the Project-alone assessment (**Section 10.12**), humpback whale and leatherback turtle are assessed qualitatively due to limited data availability, and they will therefore continue to be assessed qualitatively within the cumulative effects assessment. Humpback whale will follow the same magnitude and significance of effect as fin whale and leatherback turtle will follow delphinids (killer whale (NA) and long-finned pilot whale) as for the WDA-alone assessment.

Table 10.66 Summary of offshore windfarms screened in for piling with potential overlap with piling at the Project and relevant receptors assessed within each project's EIAR.

Project	Species Screened In													
	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white-sided dolphin	White-beaked dolphin	Risso's dolphin	Long-finned pilot whale	Minke Whale	Killer Whale	Fin Whale	Humpback Whale	Grey seal	Harbour seal	Leatherback Turtle
MachairWind Project		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Awel y Mor			✓			✓		✓						
*Dublin Array												✓		
Havbredey	✓	✓	✓		✓	✓		✓				✓	✓	
Malin Sea Wind	✓	✓	✓			✓		✓						
Mooir Vannin			✓			✓		✓						
North Channel Wind 1	✓	✓ (CWSH)	✓			✓		✓				✓	✓	
North Channel Wind 2	✓	✓ (CWSH)	✓			✓		✓				✓	✓	
Northern Irish Sea Array			✓					✓				✓	✓	
Spiorad na Mara	✓		✓	✓	✓	✓		✓				✓	✓	
*Western Star												✓	✓	

Project	Species Screened In													
	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white-sided dolphin	White-beaked dolphin	Risso's dolphin	Long-finned pilot whale	Minke Whale	Killer Whale	Fin Whale	Humpback Whale	Grey seal	Harbour seal	Leatherback Turtle
Notes: ✓ = *Included in Quantified CEA* *No EIA available, only scoping - no assessment available, used JNCC (2025b) EDRs instead.* *Not included in iPCoD due to lack of information, will be included in qualitative assessment* **Only included for wider seal MU, due to only UK portions of cetaceans in the CEA assessment*														

491. Given the stage of the above projects, limitations and constraints to project delivery and uncertainty on scheduling, a shorter list of offshore windfarm projects that could be undertaking piling activities at the same time as the Project is likely to be more realistic, but this is the best available information at the time of writing, taking a precautionary approach.

10.13.3.1.1.1 Sensitivity

492. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.1.1.2 Magnitude

493. The magnitude of potential disturbance from piling at the Project has been used to represent the worst case for all activities during all phases of the Project for the CEA. The potential numbers have been derived using the realistic worst-case disturbance numbers for all receptors from piling in **Section 10.12.1.6**.

494. For all other projects, the cumulative assessment applied disturbance numbers taken from their respective EIAs. Where numbers were not available, species density estimates were taken from their scoping reports and the 20 km EDR for piles without noise reduction mitigation (JNCC, 2025b) were applied. It should be noted that the assumed disturbance areas did not account for spatial overlap between projects, making this a highly precautionary approach. Not all individuals within the predicted effect footprint would be uniformly displaced; while some may move away from the noise source, others may remain within the area of influence and experience additional disturbance from other concurrent noise-generating activities.

495. While additive effects from multiple noise sources are possible, displacement resulting from other activities; such as piling at adjacent offshore windfarms may reduce receptor exposure to noise generated by the Project. Disturbance events could also occur elsewhere within the Wider Study Area. The potential for repeated and additive disturbances in the wider MU during the construction phase of the Project is examined through iPCoD modelling in **Section 10.13.3.1.1.3**. Piling at the MachairWind Project has been included as a worst-case element of the CEA, and it was conservatively assumed that all offshore windfarm projects would use piled foundations where this is an available option.

496. The cumulative assessment approach for piling at other offshore windfarms was based on identifying the potential for individual windfarms to be carrying out piling activities at the same time as the piling in the Project. This approach recognises that while some projects may overlap in piling periods, others may not. This represents a realistic worst-case scenario, as it is highly improbable that all projects would undertake piling simultaneously, particularly given the relatively short durations of active piling. Applying iPCoD modelling allows the complete piling schedule of each project to be incorporated, capturing both overlapping and sequential piling events over the construction period.

497. **Table 10.67** presents the density estimates used in the cumulative assessment for each receptor considered. These estimates were sourced from the respective offshore windfarm EIA and scoping reports included in the CEA. The only exception is the density estimate applied to common dolphin for North Channel Wind 1 and 2, where a density has been sourced from SCANS-IV, so that common dolphin can be included in the CEA on a precautionary basis. Receptors with no published density estimates or not assessed in the other offshore windfarm EIAs, were excluded from this cumulative assessment. Receptors that were assessed within different MUs, such as harbour porpoise in the Celtic Irish Sea MU have also been excluded as there is no overlap with the harbour porpoise WS MU.

Table 10.67 Receptor densities (km^2) used in the cumulative assessment for disturbance from piling at other offshore windfarms during piling at the MachairWind Project

Project	Harbour Porpoise*	Bottlenose Dolphin*	Common Dolphin	Atlantic White-Sided Dolphin	White-Beaked Dolphin	Risso's dolphin	Minke Whale	Fin Whale	Grey Seal*	Harbour Seal*	Leatherback Turtle
MachairWind Project	*0.42*	*0.0425 (CWSH, OW & IS)*	*0.8025*	*0.0224*	*0.2542*	*0.01*	*0.14*	*0.002*	*0.865*	*0.08*	*0.01*
Awel y Mor	-	-	0.0081	-	-	0.0022	0.0137	-	-	-	-
Dublin Array	-	-	-	-	-	-	-	-	0.017	-	-
Havbredey^	0.37	0.3421 (OW MU)	0.9266	-	0.138	0.0244	0.0353	-	-	-	-
Malin Sea Wind	0.201	0.0425 (CWSH & OW MU)	0.0544	-	-	-	0.0137	-	0.42	0.132	-
Mooir Vannin	-	-	0.0272	-	-	0.0022	0.0088	-	0.07	-	-
North Channel Wind 1	0.336	0.1206	0.0544**	-	-	0.0313	0.0271	-	-	-	-
North Channel Wind 2	0.336	0.1206	0.0544**	-	-	0.0313	0.0271	-	-	-	-
Northern Irish Sea Array	-	-	0.04	-	-	-	0.0137	-	0.421	0.115	-
Spiorad na Mara	0.308	-	0.1333	-	0.053	0.1923	0.0184	-	-	-	-
Western Star	-	-	-	-	-	-	-	1	0.00004	0.0004	-

** Only projects that are located within the same MUs as the Project's receptors have been included*

***These density estimates have been added based on updated information submitted after submission of the North Channel Wind 1 and 2 scoping report (from SCANS-IV survey Giles et al., 2023)*

^Seal densities were not included in the scoping report

10.13.3.1.1.2.1 Disturbance

498. **Table 10.59** presents the assessment of cumulative disturbance to all receptors from piling at the Project occurring at the same time as piling at offshore windfarms.

499. For this assessment, there was not enough information available for some of the windfarms because many are still at an early planning stage with only scoping reports published. Therefore, as a precautionary approach and to represent a worst-case scenario, these projects were included using density estimates from their scoping reports and the 20 km EDR for piles without noise reduction mitigation (JNCC, 2025b).

500. In the Project-alone assessment, the number of receptors potentially disturbed by piling is based on EDRs (see **Section 10.12.1.6.2.1**) rather than the worst-case values used in the dose-response curve assessment. Sinclair (2025) advises that cumulative assessments should use more realistic inputs, as applying worst-case EIAR values can lead to unrealistic over-predictions of impact. Thompson et al. (2025) demonstrated that DCRs-based estimates of harbour porpoise disturbance from impact piling in UK waters are likely to be overly conservative, and that distance-based response functions may provide a more realistic approach. Based on this evidence, the cumulative assessment for the Project uses the number of harbour porpoise predicted to be disturbed according to the EDR assessment, ensuring a realistic worst-case scenario. For other EIARs, the worst-case disturbance values have still been applied. It should be noted that values have been rounded up; therefore, where estimates were less than one individual, these have been conservatively rounded to one. It should be noted that the numbers of receptors predicted to be disturbed by piling are derived prior to the application of Project embedded mitigation, and do not take account of any mitigation measures that would be implemented by other offshore windfarm projects during piling.

501. All receptors are considered to have **medium** sensitivity to disturbance, as they can recover and move away from underwater noise generated by piling. The magnitude of cumulative disturbance from piling is assessed as **high** for bottlenose dolphin (both CWSH and OW MU); and harbour porpoise. The magnitude is assessed as **medium** for common dolphin, Risso's dolphin, minke whale, and grey seal; and **low** for white-beaked dolphin, and harbour seal. For Atlantic white-sided dolphin, killer whale, long-finned pilot whale, fin whale, humpback whale and leatherback turtle, the magnitude is assessed as **negligible** as no other offshore windfarms have included these receptors in their assessment.

Table 10.68 Quantified CEA for the potential disturbance at a single point in time for all species during single piling at the offshore windfarm projects which could be piling at the same time as the MachairWind Project. JNCC (2025b) EDRs were use for projects where they did not have disturbance numbers for species assessed in the cumulative assessment.

Project	Harbour porpoise^*	Bottlenose dolphin^*	Common dolphin	White-beaked dolphin	Risso's dolphin	Minke Whale	Grey seal^*	Harbour seal^*
MachairWind Project	*528 (EDR)*	*54 (CWSH & OW MU)*	*1,008 (EDR)*	*320 (EDR)*	*13 (EDR)*	*264 (EDR)*	*1,106 (EDR)*	*101 (EDR)*
Awel y Mor	-	-	17	-	65	36	-	-
Dublin Array	-	-	-	-	-	-	177	-
Havbredey	465 (EDR)	430 (EDR) (OW MU)	1,164 (EDR)	173 (EDR)	31 (EDR)	44	*	*
Malin Sea Wind	253 (EDR)	53^ (CWSH & OW MU)	68 (EDR)	-	3 (EDR)	17	528 (EDR)	166 (EDR)
Mooir Vannin	-		12	-	13	12	898	1
North Channel Wind 1*	422 (EDR)	152 (EDR)	68 (EDR)	-	40 (EDR)	34 (EDR)	-	-
North Channel Wind 2*	422 (EDR)	152 (EDR)	68 (EDR)	-	40 (EDR)	34 (EDR)	-	-
Northern Irish Sea Array	-		410	-	-	222	790	200
Spiorad na Mara	387 (EDR)	-**	168 (EDR)	666 (EDR)	242 (EDR)	23	8	13
Western Star	-	-	-	-	-	-	1	-
Total number and Percentage of MU (with MachairWind Project)	**2,477 (10.2% WS MU)**	**411 (100% CWSH)** **537 (41.3% OW MU)**	**2,983 (5.2% CGNS MU)**	**1,159 (3.4% CGNS MU)**	**447 (5.1% CGNS MU)**	**686 (6.6% CGNS MU)**	**3,508 (6.8% Wider MU)**	**481 (1.5% Wider MU)**
Magnitude of cumulative impact	**High**	**High**	**Medium**	**Low**	**Medium**	**Medium**	**Medium**	**Low**

Project	Harbour porpoise^*	Bottlenose dolphin^*	Common dolphin	White-beaked dolphin	Risso's dolphin	Minke Whale	Grey seal^*	Harbour seal^*
Total number and percentage of MU (without the MachairWind Project)	***1,949 (8.0% WS MU)***	***357 (100% CWSH,*** ***483 (37.1% OW MU)***	***1,975 (3.4% CGNS MU)***	***839 (2.5% CGNS MU)***	***434 (4.9% CGNS MU)***	***422 (4.1% CGNS MU)***	***2,402 (4.7% Wider MU)***	***380 (1.2% Wider MU)***
Magnitude of cumulative impact	***Medium***	***High***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

- = not included in assessment

**Seal densities were not included in the scoping report*

*** density was zero*

^ numbers rounded to nearest number

^ Only projects that are located within the same MUs as the Project's receptors have been included*

10.13.3.1.1.3 Significance of Effect

10.13.3.1.1.3.1 EDRs

502. All receptors are assigned a **medium** sensitivity to disturbance from underwater noise due to piling, as they can recover and move away (**Table 10.9**). The magnitude of cumulative disturbance from piling without any embedded mitigation is assessed as **high** for bottlenose dolphin and harbour porpoise, resulting in a **major adverse** effect, which is significant in EIA terms.

503. The magnitude is assessed as **medium** for common dolphin, Risso's dolphin, minke whale, and grey seal, resulting in a **moderate adverse** effect, which is significant in EIA terms.

504. The magnitude is assessed as **low** for white-beaked dolphin and harbour seal, resulting in a **minor adverse** effect, which is **not significant** in EIA terms (**Table 10.69**).

505. For Atlantic white-sided dolphin, killer whale, long-finned pilot whale, fin whale, humpback whale and leatherback turtle the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms (**Table 10.69**).

506. EDRs applied in this assessment were derived from harbour porpoise studies and, in the absence of comparable species-specific data, are applied to other marine mammal receptors. However, there is no empirical evidence to suggest that other species respond in the same manner as harbour porpoise, and consequently the outputs of such assessments remain subject to a high degree of uncertainty. Application of these EDRs to bottlenose dolphin initially resulted in the identification of moderate to major adverse effects. Professional judgement has therefore been applied to provide a more ecologically realistic interpretation of these results, recognising that an inflated scale effect can arise where relatively small populations (approximately 45; 189 and 1,299 individuals, respectively) lead to a disproportionately high relative proportion of the population being predicted to be affected. As a result, the initial moderate adverse assessment is considered overly precautionary.

507. The assessment adopts a highly precautionary approach by assuming that all screened-in projects would undertake piling concurrently, without any temporal or spatial overlap, and by applying project-specific worst-case parameters as reported in EIARs. Evidence from consented and constructed offshore windfarm projects demonstrates that such worst-case scenarios frequently overestimate actual construction activity. For example, at the Moray East Offshore Windfarm, the number of piles installed represented approximately 21% of the EIAR worst-case assumption, and the total number of piling days was approximately 18% of those assessed, equating to reductions in predicted impact of greater than 70% and 80%, respectively, when all other factors are held constant (Sinclair, 2025). Consequently, the use of worst-case EIAR parameters in cumulative effects assessments is a key driver of unrealistic over-prediction of impacts. This over-precaution, combined with the inherent assumption of full temporal concurrence, supports the application of professional judgement to contextualise modelled outputs and avoid misleading conclusions where predicted impacts are not representative of likely real-world conditions.

508. Taking the above considerations into account, and considering the full evidence base to ensure ecological realism, the significance of effect is assessed as **minor adverse**, which is **not significant** for bottlenose dolphin, harbour porpoise, minke whale and grey seal (**Table 10.69**).

509. As the cumulative effect of piling at other projects alongside construction at MachairWind (with piling being assessed as the worst-case) has been assessed as not being significant, MachairWind undertaking O&M and decommissioning activities at the same time as other projects' piling would also result in a **minor adverse** effect overall, which is **not significant** in EIA terms.

10.13.3.1.1.3.2 Population Modelling for Cumulative Disturbance from Offshore Windfarm Projects

510. To determine whether the modelling results indicate a materially disturbed population, predicted changes are evaluated using a threshold of a 1% annual population decline, comparing the modelled impacted and unimpacted reference populations. This threshold and the overall evidence base is used to inform the overall significance of effect. Where the population modelling predicts a decline, the significance of that change is then considered on a case-by-case basis, with assessment undertaken separately for each species.

10.13.3.1.1.3.2.1 Harbour Porpoise

511. All windfarms assessing harbour porpoise within the WS MU are Tier 2 projects. As such, there is insufficient certainty and detail on project design and timelines to robustly parameterise population-level inputs. The only exception is Spiorad na Mara, which submitted its application in February 2026, however this information was not available prior to the six-month cut-off period agreed with NatureScot, after which any new information was not able to be included in the assessment, Consequently, population modelling using iPCoD could not be undertaken for harbour porpoise.

10.13.3.1.1.3.2.2 Bottlenose Dolphin

512. All windfarms assessing bottlenose dolphin within the relevant MUs are Tier 2 projects. As such, there is insufficient certainty and detail on project design and timelines to robustly parameterise population-level inputs. Consequently, population modelling using iPCoD could not be undertaken for bottlenose dolphin.

10.13.3.1.1.3.2.3 Minke Whale

513. The population modelling for minke whale is based on:

- A worst-case of up to 522 minke whales could potentially be disturbed (comprising 264 individuals from piling at the WDA and 258 individuals from piling at other projects);
    - The worst case results for the potential number of minke whale that could be disturbed from cumulative monopile installations came from the WDA alone assessment using JNCC EDRs (2025b) (**Table 10.36**) and the disturbance numbers taken from the other offshore windfarm projects included in the minke whale cumulative assessment (**Table 10.59**); see **Appendix 10.4 iPCoD Modelling Technical Report** .
- PTS was not incorporated for minke whale due to the lack of expert elicitation or empirical data regarding PTS. Population modelling for minke whale incorporating PTS numbers from SEL_{cum} / $L_{E,p,t}$ is presented in **Appendix 10.4 iPCoD Modelling Technical Report** for information purposes as agreed with NatureScot.

514. **Plate 10.10** illustrates the mean unimpacted and impacted minke whale populations overlaid together. The results indicate that by the end of 2033, the year piling concludes and four years after disturbance begins, the median ratio of impacted to unimpacted population size is projected to be 99.98%. Beyond 2035, the impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point effect.

515. Whether mean or median values are applied, the model predicts an average annual decline of less than 1% over both the initial six-year period and the full 25-year assessment. Based on the modelling results, cumulative underwater noise effects on minke whale from piling is assessed as **negligible adverse**, which is **not significant** in EIA terms.

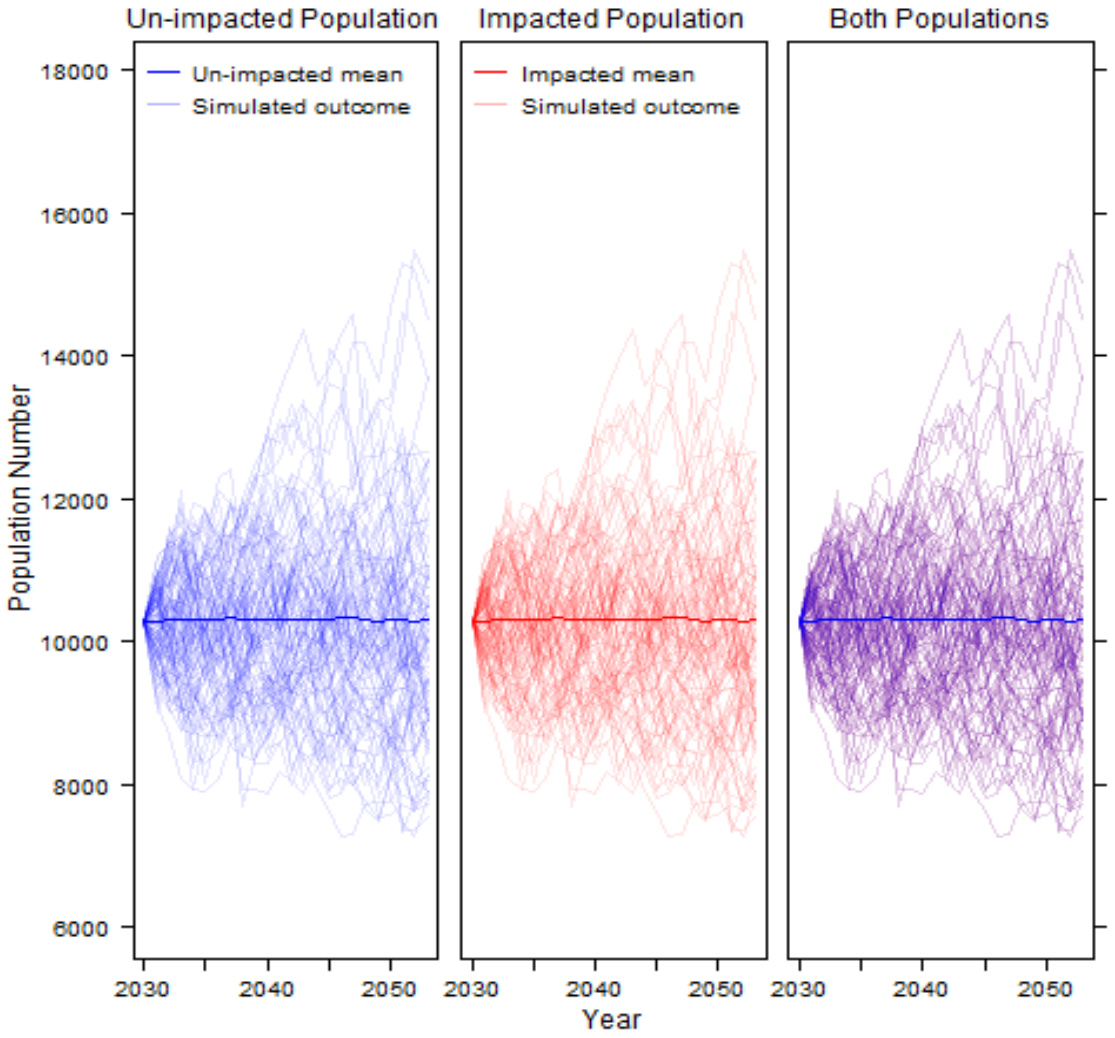


Plate 10.10 Simulated Worst-case Minke Whale Population sizes for both the Un-impacted and the Impacted Populations for the Cumulative Assessment

10.13.3.1.1.3.2.4 Grey Seal

516. The population modelling for grey seal is assessed on the wider MU only and is based on;

- A worst-case of up to 5,338 grey seals could potentially be disturbed (comprising 4,548 individuals from piling at the WDA and 790 individuals from piling at other projects);
    - The worst-case results for the potential number of grey seal that could be disturbed from cumulative monopile installations came from the WDA-alone assessment DRC assessment (**Table 10.35**) and the disturbance numbers taken from the other offshore windfarm projects included in the grey seal cumulative assessment (**Table 10.59**); (see **Appendix 10.4 iPCoD Modelling Technical Report**).
- A total of zero individuals at risk of PTS;
    - Based on the WDA-alone PTS assessment (Impact range and number of potential individuals at risk of PTS) (**Table 10.24**) and PTS numbers taken from the other offshore windfarm projects included in the grey seal cumulative assessment (see **Appendix 10.4 iPCoD Modelling Technical Report**).

517. **Plate 10.10** illustrates the mean unimpacted and impacted grey seal populations overlaid together. The numbers from the iPCoD are presented in **Appendix 10.4. iPCoD Modelling Technical Report** and indicates that by the end of 2033, the year that piling concludes and four years after disturbance begins, the median ratio of impacted to unimpacted population size is projected to be 100%. The impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point.

518. As there is less than 1% difference between the unimpacted and impacted population, in both the median and the mean since cumulative piling activities started, which is **not significant** in EIA terms.

519. Based on the modelling results and supporting evidence, cumulative underwater noise from piling is assessed as **negligible adverse** and therefore **not significant** in EIA terms. No significant cumulative impact on the grey seal population is expected.

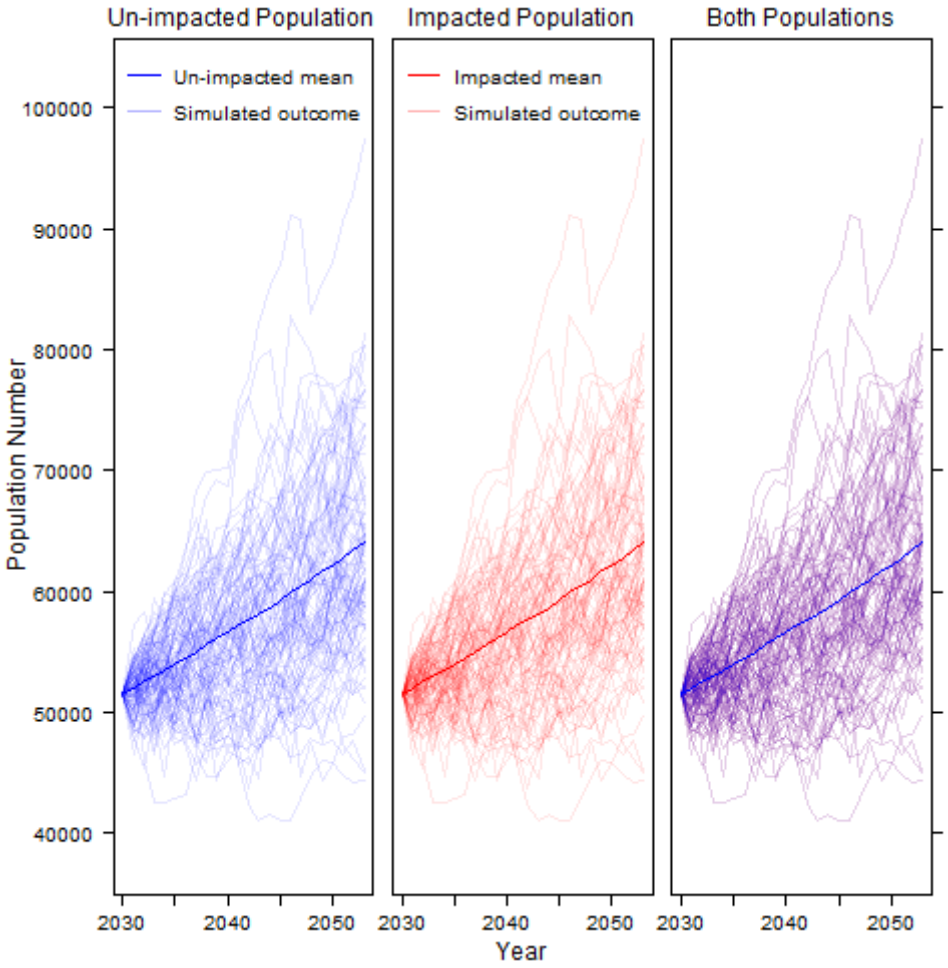


Plate 10.11 Simulated Worst-case Grey Seal Population sizes for both the Un-impacted and the Impacted Populations for the Cumulative Assessment (scientific notation used in these charts, e.g. 4e+04 = 40,000)

10.13.3.1.1.3.2.5 Harbour Seal

520. The population modelling for harbour seal is assessed on the wider MU only and is based on;

- A worst-case of up to 1,249 harbour seals could potentially be disturbed (comprising 1,049 individuals from piling at the WDA and 200 individuals from piling at other projects)

- The worst-case results for the potential number of harbour seal that could be disturbed from cumulative monopile installations came from the WDA-alone assessment for MachairWind using DRC assessment and the disturbance numbers taken from the other offshore windfarm projects included in the harbour seal cumulative assessment (**Table 10.35**) (see **Appendix 10.4 iPCoD Modelling Technical Report**).

- Zero individuals are at risk of PTS across all offshore windfarms screened in
  - Based on the WDA-alone PTS assessment (Impact range and number of potential individuals at risk of PTS) (**Table 10.24**) and PTS numbers taken from the other offshore windfarm projects included in the harbour seal cumulative assessment (see **Appendix 10.4 iPCoD Modelling Technical Report**).

521. **Plate 10.11** illustrates the mean unimpacted and impacted harbour seal populations overlaid together. The numbers from the iPCoD are presented in **Appendix 10.4 iPCoD Modelling Technical Report** and indicates that by the end of 2033, the year that piling concludes and four years after disturbance begins, the median ratio of impacted to unimpacted population size is projected to be 100%. The impacted population is expected to follow the same stable trajectory as the unimpacted population through to 2055, the modelling end point.

522. As there is less than 1% difference between the unimpacted and impacted population, in both the median and the mean since cumulative piling activities started, which is **not significant** in EIA terms.

523. Based on the modelling results and supporting evidence, cumulative underwater noise from piling is assessed as **negligible adverse** and therefore **not significant** in EIA terms. No significant cumulative impact on the harbour seal population is expected.

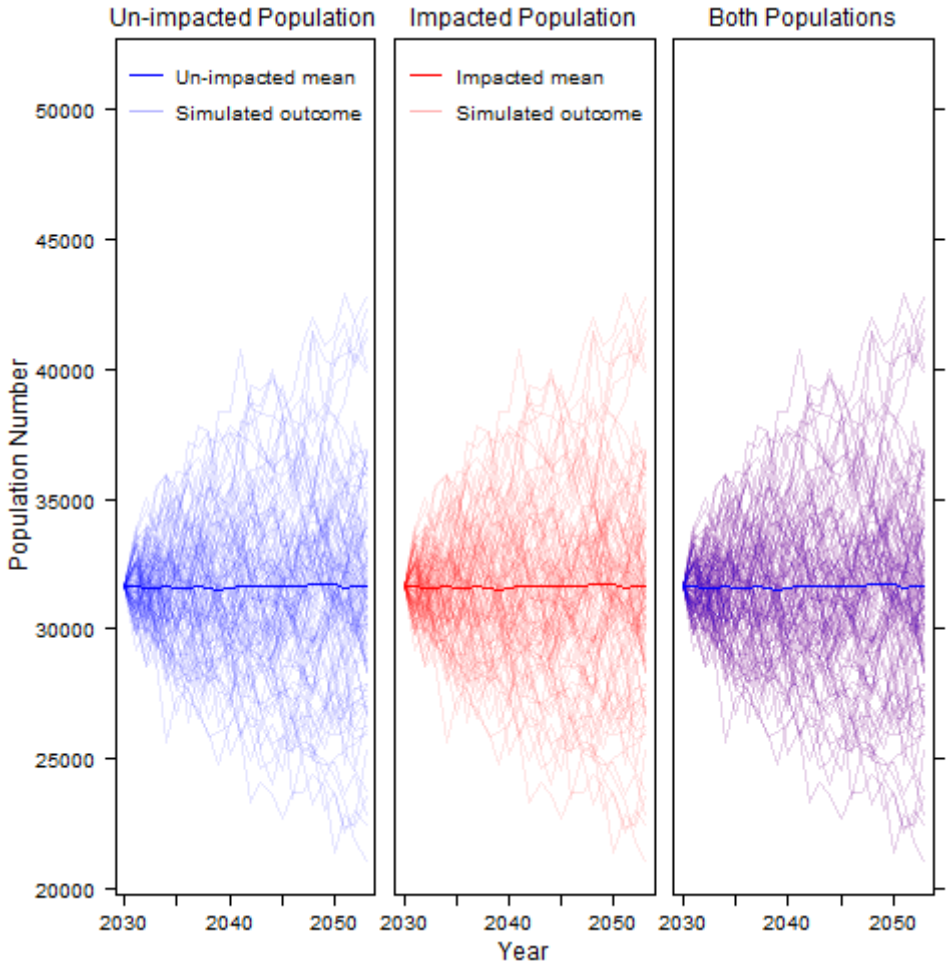


Plate 10.12 Simulated Worst-case Harbour Seal Population Sizes for Both the Un-impacted and the Impacted Populations for the Cumulative Assessment

10.13.3.1.1.3.2.6 Summary of Population Modelling

524. Cumulative disturbance from underwater noise associated with piling at the Project and other offshore windfarms has been assessed as negligible adverse for minke whale, grey seal and harbour seal, which is **not significant** in EIA terms (**Table 10.69**).

10.13.3.1.1.4 Designated Sites

525. As shown in **Table 10.7**, there are a number of marine mammal designated sites that may be affected by cumulative piling at the Project and other offshore windfarms in the Wider Study Area. For harbour porpoise, the SAC populations (of the Inner Hebrides and the Minches and Skerries and Causeway SACs) are part of the WS MU, which is the focus of the harbour porpoise assessment provided in this EIAR. There would be no significant effect on the harbour porpoise populations of either SAC, as there is no significant effect on the WS MU due to cumulative piling, as shown by **Table 10.69** below.

526. For minke whale, there is one designated site that may be affected by piling at the WDA; the Sea of the Hebrides NCMPA. Based on the NCMPA specific minke whale density, as presented in the **Report to Inform Marine Protected Area Assessment**, no other offshore windfarm projects have undertaken project-level assessments of the Sea of the Hebrides NCMPA. This reflects the fact that existing, consented, and proposed offshore wind developments are either located at sufficient

distance from the NCMPA or do not give rise to credible pathways for effects on the site's protected features.

527. For pinnipeds, there are a number of designated sites that may be affected by cumulative piling at the Project and other offshore windfarms; Treshnish Isles SAC (for grey seal), and South-East Islay Skerries, Eileanan agus Sgeiran Lios mor, Sound of Barra and Ascrib, Isay and Dunvegan SACs, all designated for harbour seal. These SAC populations are part of the wider population, which is assessed as part of the cumulative EIA assessments. As there are no significant effects on the wider population of both grey or harbour seal, there would also not be any significant effect to grey or harbour seal from cumulative pilling to any of the above listed designated sites (**Table 10.69**).

Table 10.69 Significance of effect for cumulative disturbance from underwater noise during construction at the Project and other offshore windfarms

Receptor	Sensitivity	Magnitude of Impact	Initial Conclusion on Significance of Effect	Significance of Effect	Overall Conclusion on Significance of Effect	Additional Mitigation	Residual Effect
		EDR		iPCoD	Overall conclusion		
Harbour porpoise	Medium	High	Major adverse	N/A	Minor adverse[15]	N/A	Not significant
Common dolphin & Risso's dolphin,	Medium	Medium	Moderate adverse	N/A	Minor adverse[15]	N/A	Not significant
Bottlenose dolphin		High (CWSH & OW MU)	Major adverse (CWSH & OW MU)	N/A	Minor adverse[15] (CWSH & OW MU)	N/A	Not significant
White-beaked dolphin		Low	Minor adverse	N/A	Minor adverse	N/A	Not significant
Atlantic white-sided dolphin & long-finned pilot whale		Negligible	Negligible adverse	N/A	Minor adverse	N/A	Not significant
Killer whale		Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Minor adverse (negligible adverse)	N/A	Not significant
Minke whale & grey seal		Medium	Moderate adverse	Negligible Adverse	Minor adverse[15]	N/A	Not significant
Harbour seal		Low	Minor adverse	Negligible Adverse	Minor adverse	N/A	Not significant
Leatherback turtle		Negligible	Negligible adverse	N/A	Negligible adverse	N/A	Not significant

[15]Significance of effect has been further explained at **Section 10.13.3.1.1.3**.

10.13.3.1.2 CE1b: Assessment of Underwater Noise from non-piling Activities at other Offshore Windfarms

528. Non-piling construction activities, O&M and decommissioning activities at other projects, including seabed preparation (such as sand-wave levelling, slope levelling), cable installation and protection, dredging, drilling as well as the operational noise from operating WTG could occur at the same time as construction activities at the Project, assuming piling as worst-case.

529. All offshore windfarms with construction and operational programmes that may overlap with the Project's anticipated construction window have the potential to contribute to cumulative effects.

530. Impact piling at the Project represents the worst-case noise source and underpins the conservative cumulative assessment. Other windfarms that were assessed for piling activity will not be assessed again, as piling represents the worst-case impact pathway even when multiple construction activities occur concurrently.

531. Offshore windfarms that were screened in for consideration of cumulative construction noise (excluding piling) and O&M noise were identified based on the relevant receptor MUs. Further detail on the screening process is provided in **Appendix 10.5 CEA Screening**, and the relevant projects are listed in **Table 10.70**.

10.13.3.1.2.1 Sensitivity

532. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.1.2.2 Magnitude

10.13.3.1.2.2.1 Non-piling activities

533. During the construction phase of the MachairWind Project, there is potential for temporal overlap with non-piling construction activities, O&M and decommissioning activities occurring at other offshore windfarms.

534. The Project-alone assessment and the combined assessment with the Offshore ECC for auditory injury and behavioural disturbance from non-piling activities (see **Section 10.12.1.7**) indicates that the predicted noise and disturbance ranges are substantially smaller than those associated with piling. As a result, any cumulative effects arising from simultaneous non-piling activities at nearby projects are expected to be limited.

535. Eight projects are anticipated to generate non-piling construction noise, two of which will be carrying out construction activities and six of which are anticipated to generate O&M-related noise (**Table 10.70**). Both construction and O&M noise are likely to coincide with piling at the Project for five windfarms; Arklow Bank Phase 2, Codling; Mona and Morecambe are due to be operational by 2030 and West of Orkney is due to be operational by 2029. No windfarms have been screened in for decommissioning activities. (see **Appendix 10.5 CEA Screening**) Therefore, in total eight offshore windfarms are included in the cumulative assessment as potential sources of non-piling noise during the Project construction period. However, windfarms in the Republic of Ireland (Arklow Bank Phase 2, Codling and Oriel offshore windfarms) have only been screened into the cumulative assessment for potential disturbance to seals at the wider MU scale. For cetaceans, only UK projects have been included, as the assessment is limited to the UK portion of the MU. For the MachairWind Project, as described in **Section 10.13.2**, the assessment of piling noise is included as the worst-case noise source during the lifetime of the Project. Any cumulative underwater noise effects during the Project's

O&M or decommissioning phases would therefore be less than that described for this assessment based on piling noise during construction.

536. For the potential of cumulative disturbance from non-piling activities undertaken at the same time as piling at the Project, the magnitude of impact is assessed as **high** for bottlenose dolphin (CWSH MU); **low** for harbour porpoise. bottlenose dolphin (OW MU), common dolphin, white-beaked dolphin, minke whale and grey seal. The magnitude is assessed as **negligible** for Risso's dolphin and harbour seal (**Table 10.71**). All remaining receptors are also assessed as having a **negligible** magnitude of impact, with no other projects predicting any effects on these species.

Table 10.70 Summary of other offshore windfarms screened in for non-piling activities that may occur simultaneously with the Project and relevant receptors assessed within each project's EIA

Project	Harbour Porpoise*	Bottlenose dolphin*	Common dolphin	Atlantic white-sided dolphin	White-beaked dolphin	Risso's dolphin	Killer whale	Long-finned pilot whale	Minke Whale	Fin Whale	Grey seal *	Harbour seal *
MachairWind piling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Arklow Bank - Phase 2*^	-	-	✓	-	-	✓	-	-	✓	-	✓	✓
Codling*^	-	-	-	-	-	-	-	-	-	-	✓	✓
Mona	-	-	✓	-	✓	✓	-	-	✓	-	✓	✓
Morecambe	-	-	✓	-	✓	✓	-	-	✓	-	-	-
Morgan	-	-	✓	-	✓	✓	-	-	✓	-	✓	✓
Oriel offshore windfarm*^	-	-	-	-	-	-	-	-	-	-	✓	✓
Pentland Floating offshore windfarm	✓	-	✓	-	✓	✓	-	-	✓	-	✓	✓
West of Orkney	✓	-	✓	-	✓	✓	-	-	✓	-	-	-

✓ *= Included in the assessment*

- = not included in assessment

** Only projects that are located within the same MUs as the Project's receptors have been included*

**^Only included for wider seal MU, due to only UK portions of cetaceans in the CEA assessment*

Table 10.71 Quantified CEA for the potential disturbance at a single point in time for all receptors during non-piling activities at other offshore windfarm projects which could be occurring cumulatively with the Projects construction and operation (assuming piling as the worst-case noise impact over the Project's lifetime)

Project	Harbour porpoise *	Bottlenose dolphin *	Common dolphin	White-beaked dolphin	Risso's dolphin	Minke Whale	Grey seal*	Harbour seal*
MachairWind piling	*528*	*54 (CWSH & OW MU)*	*1,008*	*320*	*13*	*264*	*1,106*	*101*
Codling*^	-	-	-	-	-	-	8	0
Arklow Bank – Part 2*^	19	-	1	-	0	0	4	0
Mona^	-	-	<1	<1	<1	<1	<1	<1
Morecambe^	-	-	3	1	0.06	1	-	-
Morgan^	-	-	<1	<1	<1	<1	<1	<1
Oriel offshore windfarm*^	-	-	-	-	-	-	85	64
Pentland Floating offshore windfarm	8	-	6	4	1	0	30	0
West of Orkney^	8	0	<1	10	0	1	29	0
Total number of receptors with piling at MachairWind	**563 (2.3% WS MU)**	**54 (100% CWSH MU)** **54 (4.1% OW MU)**	**1,021 (1.7% CGNS MU)**	**337 (0.9% CGNS MU)**	**17 (0.2% CGNS MU)**	**268 (2.6% CGNS MU)**	**1,264 (2.4% Wider MU)**	**167 (0.5% Wider MU)**
Magnitude of cumulative impact	**Low**	**High (CWSH MU)** **Low (OW MU)**	**Low**	**Low**	**Negligible**	**Low**	**Low**	**Negligible**
Total number of receptors without piling at MachairWind	***35 (0.1% WS MU)***	***0 (CWSH MU)*** ***0 (OW MU)***	***13 (0.02% CGNS MU)***	***17 (0.04% CGNS MU)***	***4 (0.05% CGNS MU)***	***4 (0.03% CGNS MU)***	***128 (0.2% Wider MU)***	***66 (0.2% Wider MU)***
Magnitude of cumulative impact (without MachairWind)	***Negligible***	***Negligible (CWSH MU)*** ***Negligible (OW MU)***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***

Project	Harbour porpoise *	Bottlenose dolphin *	Common dolphin	White-beaked dolphin	Risso's dolphin	Minke Whale	Grey seal*	Harbour seal*
- = not included in assessment								
** Only projects that are located within the same MUs as the Project's receptors have been included*								
**^Only included for wider seal MU, due to only UK portions of cetaceans in the CEA assessment*								
^ numbers rounded to nearest number								

10.13.3.1.2.2.2 Operational noise

537. Operational underwater noise from WTGs is continuous but low-level and highly localised. The closest offshore wind farm to the Project is Malin Sea Wind, approximately 41 km southeast, with North Channel Wind at 100 km and all other screened-in projects located at distances greater than 100 km. As a result, there is no spatial overlap of operational noise fields between windfarms during construction, operation or decommissioning at the Project.

538. Underwater noise modelling for the Project indicates that potential auditory injury from fixed WTGs is limited to within approximately 50 m of individual turbines. Empirical measurements from floating windfarms at Kincardine and Hywind Scotland show low-frequency, tonal operational noise that is confined to the near-field of turbines (Risch et al., 2023). Reviews of operational noise from fixed-foundation WTGs indicate source levels 10–20 dB lower than vessel noise, with cumulative noise remaining below ambient levels except very close to turbines (Tougaard et al., 2020).

539. Given the large distances between developments, the rapid attenuation of operational noise, and the absence of overlapping noise footprints, cumulative effects of disturbance from operational WTG noise during the life cycle of the Project are assessed as **negligible** for all receptors.

10.13.3.1.2.3 Significance of Effect

540. All receptors have been assigned a **medium** sensitivity to disturbance from underwater noise (**Table 10.14**). For the potential cumulative disturbance arising from non-piling activities occurring at the same time as piling at the Project, the magnitude of impact is assessed as **high** for bottlenose dolphin in the CWSH MU, resulting in a **major adverse** effect. However, considering the full evidence base to provide a more ecologically realistic interpretation, and recognising that the initial assessments are influenced by an inflated scale of effects in the calculations, the major finding is considered overly precautionary. This is largely because the MU population involved is small (approximately 45 individuals), meaning that even a modest number of animals predicted to be disturbed results in a disproportionately high percentage effect. In addition, the 4 km EDR used for disturbance is based on studies of harbour porpoise, not delphinids, and therefore likely overestimates disturbance ranges for bottlenose dolphin. For this reason, the significance of effect for bottlenose dolphin is considered to be **minor adverse**, which is **not significant** in EIA terms.

541. For non-piling activities assessed cumulatively against all phases of the Project, the magnitude is assessed as **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, white-beaked dolphin, minke whale, and grey seal, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other receptors, the magnitude is assessed as **negligible**, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

542. The magnitude for disturbance from operating WTG cumulatively during all phases of the Project is assessed as **negligible** for all receptors, resulting in a **negligible adverse** effect, which is **not significant** in EIA terms.

543. As the cumulative effect of disturbance from both non-piling activities and operational WTGs at other projects combined with piling at MachairWind, has been assessed as not being significant, the cumulative effect of MachairWind undertaking O&M and decommissioning activities at the same time as other projects undertaking other O&M activities or with operational WTGs would also result in a **minor adverse** effect overall, which is **not significant** in EIA terms.

10.13.3.1.2.4 Designated Sites

544. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by underwater noise from O&M activities and operating WTG at the Project and other offshore

windfarms. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant cumulative effects on the WS MU are predicted from underwater noise due to cumulative O&M activities and operating WTG, no significant effects are anticipated on the harbour porpoise populations supporting either SAC (**Table 10.72**).

545. For minke whale, cumulative O&M activities and operating noise from the WTG at the Project and other offshore windfarms are unlikely to result in any effects to the designated site, the Sea of the Hebrides NCMPA, as underwater noise from operating WTGs was screened out of the NCMPA specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment** and no other offshore windfarm projects have identified credible pathways for operational noise effects on the Sea of the Hebrides NCMPA. Therefore, any cumulative noise from O&M activities and operating WTG are not anticipated to result in significant effects on the NCMPA.

546. For pinnipeds, several designated sites may be affected by cumulative underwater noise due to O&M activities and operating WTG at the Project and other offshore windfarms, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites due to cumulative underwater noise from O&M activities and operating WTG in the Wider Study Area (**Table 10.72**).

Table 10.72 Assessment of significance of effect for the potential of cumulative disturbance from non-piling activities at other offshore windfarms during the life cycle of the Project

Impact	Receptor	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Effect
Cumulative effects from underwater noise from non-piling activities at other offshore windfarms at the same time as piling in the construction phase *(Impact piling at the Project represents the worst-case noise source and underpins the conservative cumulative assessment)*	Harbour porpoise, common dolphin, white-beaked dolphin, minke whale & grey seal	Medium	Low	Minor adverse	N/A	Not significant
	Bottlenose dolphin	Medium	High (CWSH MU) Low (OW MU)	Minor adverse (CWSH MU & OW MU)[16]	N/A	Not significant (CWSH MU & OW MU)
	Atlantic white-sided dolphin, Risso' dolphin, long-finned pilot whale, fin whale & humpback whale harbour seal	Medium	Negligible	Negligible adverse	N/A	Not significant
	Killer whale	Medium	Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Leatherback turtle	Medium	Negligible	Negligible adverse	N/A	Not significant
Cumulative operational noise	Harbour porpoise, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, Risso' dolphin, long-finned pilot whale, minke whale, fin whale, humpback whale & grey seal harbour seal	Medium	Negligible	Negligible adverse	N/A	Not significant
	Bottlenose dolphin	Medium	Negligible (CWSH MU & OW MU)	Negligible adverse (CWSH MU & OW MU)	N/A	Not significant (CWSH MU & OW MU)
	Killer whale	Medium	Negligible (WCC & NA)	Negligible adverse (WCC & NA)	N/A	Not significant (WCC & NA)
	Leatherback turtle	Medium	Negligible	Negligible adverse	N/A	Not significant

[16]Significance of effect changed on professional judgement, see **Section 10.13.3.1.2.3** for more information.

10.13.3.1.3 CE1c: Indicative Assessment of Underwater Noise from Other Industries and Activities

547. The following sections identify other industries that may overlap temporally with construction activities at the Project. Through the CEA screening process, only two subsea cable installation projects were identified as likely to overlap with the MachairWind construction period.

548. Other noisy activities such as geophysical surveys, seismic surveys, and UXO clearance, typically submit licence applications three to four months in advance of operations, making precise forecasting of their timing challenging. For this reason, these activities have been assessed indicatively on a worst-case basis, using project density estimates and documented EDRs, or the EDRs applied in the Project-alone assessment (see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**). Additionally, the WCC killer whale population and the wider NA population have been assessed together and are referred to as the combined MU. The populations are assessed together to provide a precautionary cumulative assessment, reflecting overlapping spatial use of the area and shared exposure to underwater noise, while acknowledging differences in population size and vulnerability.

10.13.3.1.3.1 Sensitivity

549. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.1.3.2 Magnitude of Impact

10.13.3.1.3.2.1 **Assessment of Underwater Noise Impacts from Subsea Cable Installation**

550. Two subsea cables have been screened into the cumulative assessment; LirIC Interconnector and Western Link 2. Both projects are currently at early planning stage and therefore there is limited information available on potential effects and disturbance ranges to inform the cumulative assessment. As described in **Section 10.12.1.7**, the disturbance ranges generated during cabling works and vessel operations are predicted to extend up to 4 km, equating to a disturbance area of 50.3 km² for all receptors. Density estimates and reference populations for receptors have been derived from the Machair Project. These values have been used to inform the assessments for subsea cabling and pipeline projects, as the nature of activities is comparable and no project-specific information was available for those screened in for assessment.

551. This assessment applies a precautionary approach, as there is no evidence to suggest that underwater noise generated during subsea cable installation poses a high risk of harm to marine mammals (OSPAR, 2009). Behavioural responses documented for dredging activities (which typically generate higher and more sustained underwater noise levels) are therefore used as a conservative proxy for those that may be expected during subsea cable installation. This approach is precautionary, as empirical measurements indicate that noise generated by cable installation activities, such as jetting and trenching, is substantially lower than that produced by dredging or impact piling and is often comparable to vessel noise levels (Nedwell et al., 2012).The magnitude is assessed as **high** for bottlenose dolphin (CWSH MU); **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, white-beaked dolphin, minke whale and grey seal. The magnitude is assessed as **negligible** for all other receptors (**Table 10.73**).

Table 10.73 Quantitative cumulative assessment for subsea cable installation occurring simultaneously with the Project (number of receptors, reference population, and magnitude)

Project	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white sided dolphin	White-beaked dolphin	Risso's Dolphin	Killer whale	Long-finned pilot whale	Minke Whale	Fin Whale	Grey seal	Harbour seal
Piling at the Project	528	53 (CWSH MU & OW MU)	1,008	28	320	13	1	41	264	3	1,106	101
LirIC Interconnector	10	2 (CWSH MU)	40	1	13	1	1	2	106	1	44	4
Western Link 2	10	2 (CWSH MU)	40	1	13	1	1	2	106	1	44	4
Total number of receptors with piling at MachairWind	**548 (2.25% WS MU)**	**57 (100.0% CWSH MU, 4.4% OW MU)**	**1,089 (1.9% CGNS MU)**	**30 (0.2% CGNS MU)**	**346 (1.0% CGNS MU)**	**15 (0.17% CGNS MU)**	**3 (0.02% combined MU)**	**45 (0.03% MA MU)**	**476 (4.6% CNS MU)**	**5 (0.12% NA)**	**1,194 (2.32% Wider MU)**	**109 (0.34% Wider MU)**
Magnitude of cumulative impact	**Low**	**High (CWSH MU)** **Low (OW MU)**	**Low**	**Negligible**	**Low**	**Negligible**	**Negligible**	**Negligible**	**Low**	**Negligible**	**Low**	**Negligible**
Total number of receptors without piling at MachairWind	***20 (0.08% WS MU)***	***4 (8.9% CWSH MU, 0.3% OW MU)***	***80 (0.14% CGNS MU)***	***2 (0.02% CGNS MU)***	***26 (0.08% CGNS MU)***	***2 (0.02% CGNS MU)***	***2 (0.01% combined MU)***	***4 (0.003% NA)***	***212 (2.0% CNS MU)***	***2 (0.06% NA)***	***88 (0.17% Wider MU)***	***8 (0.03% Wider MU)***
Magnitude of cumulative impact (without MachairWind)	***Negligible***	***Medium (CWSH MU)*** ***Negligible (OW MU)***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***

10.13.3.1.3.2.2 **Indicative Assessment of Underwater Noise Impacts from Geophysical Surveys at Other Projects**

552. There is potential for cumulative effects arising from geophysical surveys that could occur at other offshore windfarms, ports and other projects undertaken at the same time as construction at the Project.

553. It is currently not possible to estimate the location or number of potential geophysical surveys that could be undertaken at the same time as construction at the Project. As a precautionary approach, it is assumed that there could be up to two geophysical surveys occurring in the Wider Study Area at the same time as piling in the Project as the worst-case scenario, however, it should be noted that this is included for illustrative purposes only, and provides an indicative assessment of what the effect may be should a geophysical survey take place at the same time as piling at the Project (as the worst-case).

554. To assess for cumulative disturbance to receptors, a worst case 5 km EDR; (equating to an area of 78.54 km²) for each geophysical survey has been applied (see **Section 10.12.1.3** for the rationale of this disturbance range) and assessed against piling in the Project.

555. The magnitude is assessed as **high** for bottlenose dolphin (CWSH MU); **medium** for minke whale, **low** for harbour porpoise, bottlenose dolphin (OW MU), common dolphin, white-beaked dolphin, and grey seal. The magnitude is assessed as **negligible** for all other receptors (**Table 10.74**).

Table 10.74 Quantitative cumulative assessment for two geophysical surveys occurring simultaneously with the Project (number of receptors, reference population, and magnitude) (provided for illustrative purposes only)

Project	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white sided dolphin	White-beaked dolphin	Risso's dolphin	Killer whale	Long-finned pilot whale	Minke Whale	Fin Whale	Grey seal	Harbour seal
Piling at the Project	*528*	*54*	*1,008*	*28*	*320*	*13*	*1*	*41*	*264*	*3*	*1106*	*101*
Indicative assessment for two geophysical surveys	66	7	126	4	40	2	1	5	331	1	139	13
Total number of receptors with piling at MachairWind	**594 (2.4% WS MU)**	**61 (100% CWSH MU, 4.7% OW MU)**	**1,134 (1.98% CGNS MU)**	**32 (0.26% CGNS MU)**	**360 (1.06% CGNS MU)**	**15 (0.17% CGNS MU)**	**2 (0.01% combined MU)**	**46 (0.03.% NA)**	**595 (5.8% CGNS MU)**	**4 (0.12.% NA)**	**1,245 (2.42% Wider MU)**	**114 (0.36% Wider MU)**
Magnitude of cumulative impact	**Low**	**High (CWSH)** **Low (OW MU)**	**Low**	**Negligible**	**Low**	**Negligible**	**Negligible**	**Negligible**	**Medium**	**Negligible**	**Low**	**Negligible**
Total number of receptors without piling at MachairWind	***66 (0.3% WS MU)***	***7 (15.6% CWSH MU; 0.5% OW MU)***	***126 (0.22% CGNS MU)***	***4 (0.03% CGNS MU)***	***40 (0.12% CGNS MU)***	***2 (0.02% CGNS MU)***	***1 (0.01% combined MU)***	***5 (0.003.% NA)***	***331 (3.2% CGNS MU)***	***1 (0.03.% NA)***	***139 (0.27% Wider MU)***	***13 (0.04% Wider MU)***
Magnitude of cumulative impact (without MachairWind)	***Negligible***	***High (CWSH MU)*** ***Negligible (OW MU)***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Low***	***Negligible***	***Negligible***	***Negligible***

10.13.3.1.3.2.3 **Indicative Assessment of Underwater Noise Impacts from Seismic Surveys**

556. Seismic surveys generate high-intensity impulsive sound, typically using arrays of airguns that release compressed air into the water column to map subsea geology. These impulsive noises can travel tens to hundreds of kilometres underwater and are known to affect a range of marine species. It was not possible to estimate the location or number of seismic surveys that may occur at the same time as construction at the Project and any potential piling activity for the MachairWind Project which has been assessed as the worst case, however, it should be noted that this is included for illustrative purposes only, and provides an indicative assessment of what the effect may be should a seismic survey take place at the same time as piling at the Project (as the worst-case).

557. A systematic review of seismic effects on marine mammals and sea turtles found that seismic noise can cause behavioural changes, acoustic masking, and physiological stress, (Affatati et al., 2023), similar to the sensitivities for piling presented in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

558. As a precaution, the potential for cumulative effects from seismic surveys has been retained within the CEA. A worst-case scenario assumes that one seismic survey could be active within the Wider Study Area at the same time as the Project's construction phase.

559. For assessment purposes, it has been assumed that a single seismic survey could take place at any one time. A 10 km EDR (JNCC, 2025b) has been applied to assess the potential for cumulative disturbance from one seismic survey vessel.

560. If a single seismic survey were to occur at the same time as piling at the Project, and with no other cumulative activities, the magnitude of impact is assessed as **high** for bottlenose dolphin (CWSH MU); **medium** for bottlenose dolphin (OW MU) and minke whale, **low** for harbour porpoise, common dolphin, white-beaked dolphin, and grey seal. The magnitude is assessed as **negligible** for all other receptors (**Table 10.75**). For all other phases of the Project, the cumulative effect from seismic surveys occurring is expected to be less than during construction.

Table 10.75 Quantitative cumulative assessment for one seismic survey occurring simultaneously with the Project (number of receptors, reference population, and magnitude) (provided for illustrative purposes only)

Project	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white sided dolphin	White-beaked dolphin	Risso's dolphin	Killer whale	Long-finned pilot whale	Minke Whale	Fin Whale	Grey seal	Harbour seal
Piling at the Project	*528*	*54*	*1,008*	*28*	*320*	*13*	*1*	*41*	*264*	*3*	*1,106*	*101*
Indicative assessment for one seismic survey	132	13	252	7	80	3	1	10	660	1	276	25
Total number of receptors with piling at MachairWind	**660 (2.7% WS MU)**	**67 (100.0% CWSH MU, 5.2% OW MU)**	**1,260 (2.2% CGNS MU)**	**35 (0.3% CGNS MU**	**400 (1.2% CGNS MU**	**16 (0.2% CGNS MU**	**2 (0.01% combined MU)**	**51 (0.03% NA)**	**924 (9.0% CGNS MU**	**4 (0.1% NA)**	**1,382 (2.7% Wider MU)**	**126 (0.4% Wider MU)**
Magnitude of cumulative impact	**Low**	**High (CWSH MU)** **Medium (OW MU)**	**Low**	**Negligible**	**Low**	**Negligible**	**Negligible**	**Negligible**	**Medium**	**Negligible**	**Low**	**Negligible**
Total number of receptors without piling at MachairWind	***132 (0.5% WS MU)***	***13 (28.9% CWSH MU; 1.0% OW MU)***	***252 (0.4% CGNS MU)***	***7 (0.06% CGNS MU)***	***80 (0.2% CGNS MU)***	***3 (0.03% CGNS MU)***	***1 (0.01% combined MU)***	***10 (0.01% NA)***	***660 (6.4% CGNS MU)***	***1 (0.03% NA)***	***276 (0.5% Wider MU)***	***25 (0.08% Wider MU)***
Magnitude of cumulative impact (without MachairWind)	***Negligible***	***High (CWSH MU) Low (OW MU)***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Medium***	***Negligible***	***Negligible***	***Negligible***

10.13.3.1.3.2.4 Indicative Assessment of Underwater Noise Impacts from Clearance of UXOs at Other Projects

561. As for piling, the potential risk of PTS in receptors from cumulative effects has been screened out from further consideration in the CEA; if there is the potential for any PTS, it is likely suitable mitigation would be put in place following guidance from MD-LOT (2025); the Joint position statement (Defra, 2025) and the JNCC mitigation guidance for UXO clearance (2025a) to reduce any risk to marine mammals. Therefore, the CEA only considers potential disturbance effects.

562. It was not possible to estimate the number of potential UXO clearance events that could occur simultaneously with construction and any potential piling activity at the MachairWind Project.

563. This assessment considers the potential for disturbance arising from UXO clearance activities associated with other projects, occurring cumulatively with construction activities, with piling assumed as the worst-case scenario at the Project. As it is not currently possible to determine how many UXO clearance events may occur concurrently with potential piling at the Project, a worst-case approach has been adopted. This assumes that one high-order detonation and one low-order detonation could occur at the same time as Project construction which is a precautionary approach. It should be noted that this is included for illustrative purposes only and provides an indicative assessment of what the effect may be should a UXO clearance take place at the same time as piling at the Project (as the worst-case).

564. The magnitude of potential disturbance from UXO clearance has been assessed using a 20 km EDR, resulting in an impact area of 1,256.6 km² for any high-order clearance without any embedded or additional mitigation. For low-order clearance, a disturbance area of 78.5 km² has been applied (JNCC, 2025b).

565. If one high-order and one low-order UXO clearance was to occur at the same time as piling in the Project and with no other cumulative activities, the magnitude of impact is assessed as **high** for bottlenose dolphin (CWSH MU); **medium** for bottlenose dolphin (OW MU) and minke whale. The magnitude is assessed as **low** for harbour porpoise, common dolphin, white-beaked dolphin and grey seal. For all other receptors the magnitude is assessed as **negligible** (**Table 10.76**). For all other phases of the Project the cumulative effect from UXO clearance occurring is expected to be less than during construction.

Table 10.76 Quantitative cumulative assessment for one seismic survey occurring simultaneously with the Project (number of receptors, reference population, and magnitude) (provided for illustrative purposes only)

Projects	Harbour porpoise	Bottlenose dolphin	Common dolphin	Atlantic white sided dolphin	White-beaked dolphin	Risso's dolphin	Killer whale	Long-finned pilot whale	Minke Whale	Fin Whale	Grey seal	Harbour seal
Piling at the Project	*528*	*54*	*1,008*	*28*	*320*	*13*	*1*	*41*	*264*	*3*	*1,106*	*101*
Indicative assessment for one low-order clearance	33	3	63	2	20	1	1	3	165	1	69	6
Indicative assessment for one high-order clearance	528	54	1,008	28	320	13	1	41	264	3	1,106	101
Total number of receptors with piling at MachairWind	**1,089 (4.5% WS MU)**	**111 (100% CWSH MU; 8.5% OW MU)**	**2,079 (3.63% CGNS MU)**	**58 (0.5% CGNS MU)**	**660 (1.9% CGNS MU)**	**27 (0.3% CGNS MU)**	**3 (0.02% combined MU)**	**85 (0.06% NA)**	**693 (6.7% CGNS MU)**	**7 (0.2% NA)**	**2,281 (4.4% Wider MU)**	**208 (0.6% Wider MU)**
Magnitude of cumulative impact	**Low**	**High (CWSH MU)** **Medium (OW MU)**	**Low**	**Negligible**	**Low**	**Negligible**	**Negligible**	**Negligible**	**Medium**	**Negligible**	**Low**	**Negligible**
Total number of marine mammals without piling at MachairWind	***561 (2.3% WS MU)***	***57 (100% CWSH MU; 4.4% OW MU)***	***1,071 (3.63% CGNS MU)***	***30 (0.2% CGNS MU)***	***340 (1.0% CGNS MU)***	***14 (0.2% CGNS MU)***	***2 (0.01% combined MU)***	***44 (0.03% NA)***	***429 (4.2% CGNS MU)***	***4 (0.1% NA)***	***1,175 (2.3% Wider MU)***	***107 (0.3% Wider MU)***
Magnitude of cumulative impact	***Low***	***High (CWSH MU)*** ***Low (OW MU)***	***Low***	***Negligible***	***Low***	***Negligible***	***Negligible***	***Negligible***	***Low***	***Negligible***	***Low***	***Negligible***

10.13.3.1.4 CE1d: Combined Disturbance from Underwater Noise from All Other Industries and Activities

566. **Table 10.77** presents all noisy activities that could potentially coincide with the Project (taking piling as a worst-case for the Project's lifetime). This includes construction activities at other offshore windfarms, as well as other noise-generating activities for which a quantitative assessment can be undertaken. Additional activities such as geophysical surveys, seismic surveys, and UXO clearance are shown as indicative only, as the timing of these activities is uncertain. Any such activities would be subject to separate licensing processes, which would be required to take account of the consented activities at the Project in their assessment. The final cumulative assessment does not include these indicative activities.

10.13.3.1.4.1 Sensitivity

567. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.1.4.2 Magnitude of Impact

568. The indicative approach has been used to determine the potential magnitude of cumulative effects should all listed noisy activities occur concurrently. **Table 10.77** presents the potential magnitude of cumulative disturbance.

569. The magnitude of impact is assessed as **high** for bottlenose dolphin (for both the CWSH and OW populations), **medium** for harbour porpoise, common dolphin, minke whale and grey seal. The magnitude is assessed as **low** for white-beaked dolphin, Risso's dolphin and harbour seal, and **negligible** for all other receptors (**Table 10.77**). It should be noted that the magnitude of impact on the relevant MUs for each species is the same without the effect from the Project for all species except harbour porpoise and common dolphin, which both reduce from a medium magnitude to low.

Table 10.77 Quantitative cumulative assessment for all indicative noisy activities occurring during the life cycle of the Project (number of receptors, reference population, and magnitude) (Grey shaded cells indicate indicative projects that may not occur in-combination with piling at the Project)

Activity	Harbour porpoise	Bottlenose dolphin (CWSH)	Bottlenose dolphin (OW)	Common dolphin	Atlantic white sided dolphin	White-beaked dolphin	Risso's dolphin	Killer whale	Long-finned pilot whale	Minke whale	Fin whale	Grey seal	Harbour seal
Piling at the Project	528	54	54	1,008	28	320	13	1	41	264	3	1,106	101
Piling at other windfarms	1,949	357	483	1,975	0	839	434	0	0	422	0	2,402	380
Non-piling noise at other windfarms	35	0	0	14	0	19	4	0	0	6	0	128	66
Subsea cables	20	4	4	81	2	26	2	2	4	212	2	88	8
Two geophysical surveys	*66*	*7*	*7*	*126*	*4*	*40*	*2*	*1*	*5*	*331*	*1*	*139*	*13*
One seismic survey	*132*	*13*	*13*	*252*	*7*	*80*	*3*	*1*	*10*	*660*	*1*	*276*	*25*
UXO clearance (one high-order and one low-order)	*561*	*57*	*57*	*1,071*	*30*	*340*	*14*	*2*	*44*	*429*	*4*	*1,175*	*107*
Total number of receptors piling at MachairWind (without indicative projects)	**2,532 (10.4% WS MU)**	**415 (100% CWSH MU)**	**541 (41.6% OW MU)**	**3,078 (5.4% CGNS MU)**	**30 (0.2% CGNS MU)**	**1,204 (3.5% CGNS MU)**	**453 (5.2% CGNS MU)**	**3 (0.02% Combined MU)**	**45 (0.1% NA)**	**904 (8.8% CGNS MU)**	**5 (0.2% NA)**	**3,724 (7.2% Wider MU)**	**555 (1.8% Wider MU)**
Magnitude of cumulative impact	**High**	**High**	**High**	**Medium**	**Negligible**	**Low**	**Medium**	**Negligible**	**Negligible**	**Medium**	**Negligible**	**Medium**	**Low**
Total number of receptors without piling at MachairWind (without indicative projects)	***2,004 (8.2% WS MU)***	***361 (100% CWSH MU)***	***487 (37.5% OW MU)***	***2,070 (3.6% CGNS MU)***	***2 (0.02% CGNS MU)***	***884 (2.6% CGNS MU)***	***440 (5.1% CGNS MU)***	***2 (0.01% Combined MU)***	***4 (0.003% NA)***	***640 (6.2% CGNS MU)***	***2 (0.1% NA)***	***2,618 (5.1% Wider MU)***	***454 (1.4% Wider MU)***
Magnitude of cumulative impact	***Medium***	***High***	***High***	***Low***	***Negligible***	***Low***	***Medium***	***Negligible***	***Negligible***	***Medium***	***Negligible***	***Medium***	***Low***
Total number of receptors with piling at MachairWind with indicative projects	***3,291 (13.5% WS MU)***	***492 (100% CWSH MU)***	***618 (47.5% OW MU)***	***4,527 (7.9% CGNS MU)***	***71 (0.6% CGNS MU)***	***1,664 (4.9% CGNS MU)***	***472 (5.4% CGNHS MU)***	***7 (0.05% Combined MU)***	***104 (0.1% NA)***	***2,324 (22.6% CGNS MU)***	***11 (0.3% NA)***	***5,314 (10.3% Wider MU)***	***700 (2.2% Wider MU)***
Magnitude of cumulative impact	***High***	***High***	***High***	***Medium***	***Negligible***	***Low***	***Medium***	***Negligible***	***Negligible***	***High***	***Negligible***	***High***	***Low***

10.1.1.1.1 Significance of Effect of Cumulative Effect 1

570. All receptors have been assigned a medium sensitivity to disturbance from underwater noise (**Table 10.14**; see **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**). The initial cumulative assessment of disturbance from underwater noise arising from other industries and activities identified a high magnitude of impact for bottlenose dolphin, resulting in major adverse effects (significant in EIA terms). A medium magnitude was identified for harbour porpoise, common dolphin, minke whale and grey seal (moderate adverse and significant in EIA terms), while a low magnitude was identified for white-beaked dolphin, Risso's dolphin and harbour seal, and negligible for all other receptors (minor or negligible adverse, not significant in EIA terms).

571. However, for the reasons described in **Section 10.13.3.1.1.3**, and following the application of professional judgement, the significance of effect for harbour porpoise, bottlenose dolphin, common dolphin, minke whale and grey seal has been reassessed as minor adverse and not significant in EIA terms (**Table 10.69** and **Table 10.78**). This reflects that a substantial proportion of the initially predicted moderate to major adverse effects is driven by highly precautionary assumptions, particularly the assumption that all relevant noise-generating activities (including piling) will occur concurrently.

572. The assessment also represents a conservative snapshot of disturbance at a single point in time. Effects are expected to be temporary and recoverable, and repeated disturbance events are not anticipated to result in population-level effects. Overall confidence in the cumulative assessment is considered medium to low, reflecting uncertainties in the availability, quality and resolution of data from other plans and projects, as well as limitations in characterising population-level responses to multiple concurrent activities. While consistent disturbance ranges and population density datasets have been applied where possible, the likelihood of all assessed plans and projects occurring simultaneously is considered low. In practice, construction and preparatory activities would be programmed, spatially separated and subject to regulatory controls, making extensive temporal and spatial overlap unlikely. The assessment is therefore considered conservative, and actual disturbance levels are expected to be lower than predicted.

573. The initial identification of moderate to major adverse effects for bottlenose dolphin and minke whale is further driven by the use of EDRs derived from harbour porpoise studies. Harbour porpoises are recognised as more sensitive to underwater noise than many other cetaceans, and there is no evidence that other receptors respond in the same manner. For bottlenose dolphin, the use of a small MU results in a disproportionate percentage of individuals being predicted as disturbed, inflating the magnitude of impact. Taking these factors into account, the application of professional judgement indicates that the initial outcomes are overly precautionary, and that a minor adverse, not significant conclusion is more appropriate.

574. Cumulative disturbance from underwater noise from the Project, based on piling within the WDA as the worst-case and piling at other offshore windfarms, has been assessed as minor adverse or negligible adverse for all receptors. Population modelling could not be undertaken for harbour porpoise or bottlenose dolphin due to insufficient data; however, modelling for minke whale, grey seal and harbour seal indicates that, while temporary disturbance may occur, no population-level effects are predicted, and recovery is expected to be relatively rapid. For all other Project phases, and for non-piling underwater noise occurring concurrently with piling during construction, cumulative effects are expected to be equal to or less than those predicted for construction, with piling remaining the dominant sound source.

575. On this basis and taking account of the precautionary nature of the assumptions applied, the cumulative significance of effects previously identified as moderate or major adverse has been

appropriately revised to **minor adverse** for the construction, O&M, and decommissioning phases, which is **not significant** in EIA terms.

576. As the cumulative effect of other noisy activities and projects taking place at the same time as MachairWind undertaking construction (with piling being assessed as the worst-case) has been assessed as not being significant, MachairWind undertaking O&M and decommissioning activities at the same time as other noisy projects and activities would also result in a **minor adverse** effect overall, which is **not significant** in EIA terms.

10.13.3.1.4.3 Designated Sites

577. As shown in **Table 10.7**, there are a number of marine mammal designated sites that may be affected by cumulative noise from construction and operational noise at the Project and multiple windfarms, plus noise sources from seismic and geophysical surveys, UXO clearance, and subsea cables which could be from non-windfarm projects. For harbour porpoise, the SAC populations (of the Inner Hebrides and the Minches and Skerries and Causeway SACs) are part of the WS MU, which is the focus of the harbour porpoise assessment provided in this EIAR and cumulative assessment. There would be no significant effect on the harbour porpoise populations of either SAC, as there is no significant effect on the WS MU due to cumulative underwater noise emitted from combined sources (**Table 10.78**).

578. For minke whale, there is one designated site that may be affected by cumulative noise at the Project and at other projects i.e. the Sea of the Hebrides NCMPA. However, no other projects have identified credible pathways for underwater noise effects on the Sea of the Hebrides NCMPA. Therefore, any cumulative noise from noisy activities is not anticipated to result in significant effects on the NCMPA.

579. For pinnipeds, there are a number of designated sites that may be affected by cumulative noise at the Project and other projects; Treshnish Isles SAC (for grey seal), and South-East Islay Skerries, Eileanan agus Sgeiran Lios mor, Sound of Barra and Ascrib, Isay and Dunvegan SACs, all designated for harbour seal. These SAC populations are part of the wider population, which is assessed as part of the EIAR cumulative assessments. As there are no significant effects on the wider populations, there would also not be any significant effect to grey or harbour seal of any of the above listed designated sites (**Table 10.78**).

Table 10.78 Assessment of significance of effect for the potential of cumulative disturbance from all noisy activities combined during the life cycle of the Project

Impact	Receptor	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Effect
Cumulative effects from underwater noise from all other activities combined at the same time as piling in Project	Harbour porpoise	Medium	High	Minor adverse[17]	N/A	Not significant
	Bottlenose dolphin		High (CWSH & OW MU)	Minor adverse[17](CWSH & OW MU)	N/A	Not significant
	Common dolphin, Risso's dolphin, minke whale and grey seal		Medium	Minor adverse[17]	N/A	Not significant
	Atlantic white-sided dolphin, long-finned pilot whale, fin whale & Humpback whale		Negligible	Minor adverse	N/A	Not significant
	White-beaked dolphin & harbour seal		Low	Minor adverse	N/A	Not significant
	Killer whale		Negligible (Combined MU)	Negligible adverse (Combined MU)	N/A	Not significant
	Leatherback turtle		Negligible	Negligible adverse	N/A	Not significant

[17]Significance of effect changed on professional judgement, see **Section 10.13.3.1.3** for more information.

10.13.3.2 Cumulative Effect 2: Assessment of Underwater Noise and Presence of Vessels

580. It is challenging to quantify cumulative disturbance arising from increased vessel activity, as vessel traffic varies considerably across both time and space between different offshore projects. This variability is further impacted by the natural movement patterns and seasonal shifts in distribution of marine mammals and leatherback turtle across the wider study area.

581. Most vessel movements travelling to and from offshore windfarms and other offshore developments will follow established navigation routes used by existing commercial and fishing vessels. Marine mammals in the region are therefore likely to be familiar with, and in some cases habituated to, typical levels of vessel activity. As a result, any additional disturbance risk is mainly associated with the specific activity footprint of the Project. Vessel traffic related to offshore wind operations is generally infrequent and involves slow-moving or stationary vessels, reducing the risk of disturbance. Industry-standard mitigation measures are also routinely implemented to minimise potential disturbance to marine mammals.

582. For projects screened into the cumulative assessment with construction and O&M phases that may overlap with MachairWind, **Table 10.79** summarises anticipated vessel numbers and associated vessel trip activity where available. These projects are generally located along established port-to-sea shipping routes. Beyond approximately 100 km from the MachairWind Project, effects associated with vessel movements are expected to be increasingly dispersed and localised and therefore **not significant**.

583. The number of vessels and transfers presented in **Table 10.79** were sourced from all project-related reports available at the time this assessment was prepared.

Table 10.79 Summary of the number of construction/O&M vessels for the screened in projects that are overlapping with the MachairWind Project construction

Project	Phase Screened In	Maximum Number of Vessels on Site at Any One Time	Vessel Transits	Distance to MachairWind Project (km)
MachairWind Project	Construction	Construction: 117 O&M: 13	Construction: 5,699 O&M: 423	N/A
Arklow Bank - Phase 2	Construction/ Operational	Construction: 67 O&M: 20	Construction: 4,150 Operational: 1,395	330 km
Awel y Mor	Construction	101	N/A	328 km
Codling	Operational	14	1,209	306 km
Dublin Array	Construction	18	75	300 km
Havbredey	Construction	N/A	N/A	301 km
Malin Sea Wind	Construction	N/A	N/A	41 km
Mona	Construction	96	2,199	255 km
Mooir Vannin	Construction	30	2,980	224 km
Morecambe	Construction	37	2,583	304 km

Project	Phase Screened In	Maximum Number of Vessels on Site at Any One Time	Vessel Transits	Distance to MachairWind Project (km)
Morgan	Construction	96	1,929	290 km
North Channel Wind 1	Operational	N/A	N/A	100 km
North Channel Wind 2	Operational	N/A	N/A	142 km
North Irish Sea Array	Construction	69 (47 simultaneously)	2,530	244 km
Pentland Floating Offshore windfarm	Operational	N/A	N/A	324 km
Spiorad na Mara	Construction	N/A	N/A	244 km
West of Orkney	Construction/Operational	Construction: 101 Operation: N/A	Construction: 1,772 Operation: 12,656	330 km
Western Star	Construction	N/A	N/A	N/A
N/A – no information available				

10.13.3.2.1 CE2a: Vessel Disturbance

10.13.3.2.1.1 Sensitivity

584. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.2.1.2 Magnitude

10.13.3.2.1.2.1 Construction

585. **Table 10.79** represents an absolute worst-case scenario for vessel presence within the Wider Study Area. In practice, the number of vessels operating concurrently is expected to be substantially lower. Available information for projects with construction or O&M activities potentially overlapping with the Project construction phase indicates that, where published data are available, approximately 679 vessels may be operating at representative offshore windfarms at any one time (**Table 10.79**). In addition, regular vessel transits between the Project and other windfarm sites are estimated to comprise a minimum of 25,126 movements over the Project construction phase, representing the worst-case scenario. However, vessel movements are likely to be widely distributed across the Wider Study Area with the closest windfarm being Malin Sea Wind approximately 41 km away and North Channel 1 Windfarm at 100 km away (see **Appendix 10.5 Cumulative Effects Assessment Screening**). Various ports are also likely to be utilised from other windfarms. Therefore, it is unrealistic to assume that the maximum number of vessels from each neighbouring project would be operating simultaneously alongside the full complement of vessels associated with the Project. Producing a quantified cumulative estimate using these maximum figures would therefore not represent real-world conditions and would likely overstate vessel activity by ignoring spatial and temporal separation between disturbance footprints.

586. Although research indicates that marine mammals can exhibit a degree of habituation to regular vessel traffic (e.g. Nowacek et al., 2007; Hudson, 2014b; Onoufriou et al., 2016b; Jones et al., 2017b; Koroza & Evans, 2022), short-term displacement remains a possible behavioural response. Any increases in vessel activity associated with construction will be temporary, widely distributed and fluctuate according to the construction stages of individual projects. Marine mammals and leatherback turtle are expected to return to affected areas once vessels pass through (Richardson et al., 1995; Moweacek et al., 2007; Wier., 2007). As a result, construction-related vessel presence is assigned a **low** magnitude of impact, given that any disturbance will be localised, short-lived, and limited to the approximate five-year construction period of the MachairWind project.

10.13.3.2.1.2.2 O&M

587. During the O&M phase of the Project, other offshore windfarms will be in operation, meaning that overlapping O&M activity could increase vessel presence in the wider region. This has the potential to cause disturbance to marine mammals and leatherback turtle moving through or foraging within the Wider Study Area.

588. Available information for projects in the vicinity of the Project (see **Table 10.79**) indicates that, for those with published data, there would be less vessel activity confined to other windfarms and less vessel transits, compared to the numbers assessed during the Projects construction phase. Additionally maintenance operations are spread throughout the year, meaning vessels are deployed intermittently rather than simultaneously. It is therefore highly unlikely that all O&M vessels for every project would be active at the same time/day as vessel activity in the Project.

589. Marine mammals and leatherback turtles may be repeatedly exposed to vessel traffic during O&M activities at windfarms, though long-term impacts of shipping noise remain difficult to quantify. Documented effects are generally short-term behavioural responses for marine mammals followed by recovery (Wisniewska et al., 2018a; New et al., 2020; Hao et al., 2024). Monitoring at operational offshore windfarms indicates that any disturbance from vessels is typically localised and temporary, with harbour porpoise and seals continuing to forage within these areas and showing no substantial long-term displacement (Diederichs et al., 2008a; Teilmann et al., 2006b; McConnell et al., 2012; Lindeboom et al., 2011; Russell et al., 2014b; Leemans and Fijn, 2023).

590. Operational vessels conduct activities similar to construction vessels but far less frequently, and harbour seals have been shown to continue foraging even during construction activities, indicating tolerance (Russell, 2016a). Vessel movements to the screened-in projects will largely follow established shipping routes, meaning marine mammals and leatherback turtles in these areas are likely already accustomed to typical vessel activity. Offshore windfarms are likely to be required to implement EMPs with measures to reduce vessel disturbance and collision, similar to those proposed for MachairWind.

591. Once on site, O&M vessels typically remain stationary or move slowly while carrying out required tasks. AIS data analysis of maintenance vessels at an operational offshore windfarm showed that vessels spend much of their time stationary or moving at very low speeds within the array during maintenance and turbine access activities, with higher transit speeds largely restricted to journeys between port and site (Baghizadeh et al., 2025). This substantially reduces their disturbance potential (Erbe et al., 2019; Findlay et al., 2023; OSPAR, 2023). In a worst-case scenario, if several vessels were present within an array area at the same time, the site could temporarily become a localised disturbance hotspot. However, the spacing between turbines and open transit corridors within the array would continue to provide marine mammals and leatherback turtle with sufficient space to move between areas and access foraging grounds, haul-out sites, or broader migratory routes.

592. The magnitude of impact is therefore considered to be **low** but is considered a long-term impact due to the presence of O&M vessels as a continuous impact.

10.13.3.2.1.2.3 Decommissioning

593. During the decommissioning phase of the Project, other offshore windfarms could also be undergoing decommissioning activities and therefore overlapping activity could increase vessel presence in the wider region. This has the potential to cause disturbance to marine mammals and leatherback turtle moving through or foraging within the Wider Study Area. At this stage, there is no information on the number of vessels that would be required for the Project's and other projects in decommissioning phases, however it is likely to be similar or less than the construction phase and therefore a **low** magnitude of impact is assigned in line with construction.

10.13.3.2.1.3 Significance of Effect

10.13.3.2.1.3.1 Construction

594. Embedded mitigation measures (see **Section 10.10**) to reduce the risk of vessel disturbance with all receptors, including compliance with the Scottish Marine Wildlife Watching Code and as secured through **Appendix 6 Outline EMP** (see **Table 10.8**) will reduce any risk of exposure to underwater noise and disturbance.

595. The significance of effect of cumulative disturbance from vessels on marine mammals and leatherback turtle during the five-year construction phase of the MachairWind Project, on the basis that embedded mitigation is implemented, are not expected to exceed those assessed for the WDA-alone. With a sensitivity of **medium** to **low** (**Table 10.14**) and a **low** magnitude, a **minor adverse** effect is predicted for all marine mammal receptors, which is **not significant** in EIA terms.

10.13.3.2.1.3.2 O&M

596. Available measures to reduce the potential level of disturbance from vessels are included in **Appendix 6 Outline EMP** (see **Table 10.8**).

597. The effect of cumulative disturbance from vessels on marine mammals and leatherback turtle during the 35-year operational phase of the MachairWind Project with a **medium** to **low** sensitivity and a **low** magnitude would result in a **minor adverse** effect, which is **not significant** in EIA terms.

10.13.3.2.1.3.3 Decommissioning

598. The impact from decommissioning is expected to be the same or less than the effect assessed during the construction phase. As such, the effect of cumulative disturbance from vessels on marine mammals and leatherback turtle with a **medium** to **low** sensitivity would result in a **minor adverse** effect for all marine mammal receptors, which is **not significant** in EIA terms.

10.13.3.2.2 CE2b: Vessel Collision Risk

10.13.3.2.2.1 Sensitivity

599. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.2.2.2 Magnitude

600. As noted in **Section 10.12.1.10,** the increased collision risk associated with construction and O&M vessel movements for the MachairWind Project was assessed as **minor adverse** (and therefore **not**

significant in EIA terms). Industry practice measures to minimise collision risk were identified for all marine mammal species.

601. To reduce any potential collision risk, vessel transit routes will, where feasible, follow established and recognised shipping corridors, where marine mammals and leatherback turtles are already accustomed to vessel presence. Vessel movements will be limited to the minimum required, and vessel speeds will be reduced wherever practicable. Operators will also follow industry practice to avoid collisions with marine mammals, as outlined in **Appendix 6 Outline EMP**). Comparable measures are expected to be a requirement for other offshore industries, further reducing the likelihood of cumulative collision risks.

602. Because vessel traffic to and from ports will be routed along existing navigation pathways wherever practicable, the increase in vessel numbers related to offshore windfarm developments will be unlikely to lead to significant increases in collision risk. Once on site, vessels associated with offshore wind construction will either be stationary or move at low speeds while undertaking their activities. As a result, any cumulative increase in collision risk to marine mammals and leatherback turtles is expected to be negligible.

603. Based on the above, and with best practice measures applied, the cumulative magnitude of impact during construction is assessed as **low**.

10.13.3.2.2.3 Significance of Effect

10.13.3.2.2.3.1 Construction

604. Embedded mitigation measures (see **Section 10.10**) to reduce the risk of collision risk from vessels with all receptors, including adherence to the Scottish Marine Wildlife Watching Code as secured through **Appendix 6 Outline EMP** (see **Table 10.8**) will reduce any risk of exposure to underwater noise and disturbance and collision risk.

605. The significance of effect of the cumulative risk of vessel collision on receptors during the five-year construction phase of the MachairWind Project, on the basis that embedded mitigation is implemented, is not expected to exceed those assessed for the WDA-alone, with other survey/windfarm vessels following shipping routes and their own mitigation measures. With a sensitivity of **low** to **medium** (**Table 10.14**) and a **low** magnitude a **minor adverse** effect for all marine mammal receptors is predicted, which is **not significant** in EIA terms.

10.13.3.2.2.3.2 O&M

606. Available measures to reduce the potential level of disturbance from vessels are included in **Appendix 6 Outline EMP** (see **Table 10.8**). It is likely that other projects would be required to implement industry standard mitigation measures too.

607. The effect of cumulative disturbance from vessels on marine mammals and leatherback turtle during the 35-year operational phase of the MachairWind Project, with a **medium** to **low** sensitivity and on the basis that embedded mitigation is implemented, a **low** magnitude would result in a **minor adverse** effect, which is **not significant** in EIA terms.

10.13.3.2.2.3.3 Decommissioning

608. The impact from decommissioning is expected to be the same or less than the effect assessed during the construction phase. As such, the effect of cumulative disturbance from vessels on marine mammals and leatherback turtle with a **medium** to **low** sensitivity would result in a **minor adverse** effect for all marine mammal receptors, which is **not significant** in EIA terms.

10.13.3.2.2.4 Designated Sites

609. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by cumulative disturbance and collision risk arising from an increase in vessel activity within the Wider Study Area. For harbour porpoise, the qualifying populations of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted as a result of cumulative vessel collision risk, no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

610. For minke whale, a single designated site may potentially be affected by cumulative vessel disturbance and collision risk associated with increased vessel activity within the Wider Study Area i.e. the Sea of the Hebrides NCMPA. Based on the NCMPA-specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment**, evidence indicates that reported ship-strike incidence for minke whales is lower than for some larger mysticete species, and vessel collision risk is not currently considered a primary pressure on the species at the population level in Scottish waters, including within the NCMPA (NatureScot, 2020; IWC, 2022). With respect to cumulative disturbance, no other offshore windfarm EIARs have identified effects on the Sea of the Hebrides NCMPA; therefore, cumulative effects from vessel disturbance and collision risk are considered unlikely. For this reason, it is concluded that increased vessel activity would not result in significant effects on the NCMPA.

611. For pinnipeds, several designated sites may potentially be affected by cumulative vessel disturbance and collision risk, primarily due to increased vessel transits. These include the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional grey and harbour seal populations assessed within this EIAR. As no significant effects on the wider grey seal or harbour seal populations are predicted, no significant effects are anticipated for grey seal or harbour seal at any of these designated sites as a result of vessel collision risk.

10.1.1.2 Cumulative Effect 3: Barrier Effects from underwater noise

10.13.3.2.2.5 Sensitivity

612. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.2.2.6 Magnitude

613. Underwater noise generated during construction and non-piling activities has the potential to cause behavioural avoidance and, in certain coastal or confined settings, may create temporary acoustic barriers for marine mammals and leatherback turtle. In a cumulative context, such barrier effects could theoretically arise where multiple noisy activities occur in close proximity, potentially restricting movement or access to preferred habitats. However, projects within the wider region, are over 100 km from the Project, with exception to Malin Sea Wind approximately 41 km away and North Channel 1 Windfarm at 100 km away (see **Appendix 10.5 Cumulative Effects Assessment Screening**). This shows that the offshore windfarms are spatially separated and will therefore not form a continuous noise footprint. As a result, cumulative underwater noise would not create a persistent or large-scale acoustic barrier.

614. Furthermore, the Project and surrounding areas contain multiple open transit routes between islands and OW, providing sufficient alternative pathways for receptors to move around temporary noise sources. Taking into account the spacing of projects, the limited duration of noisy activities, and the wide-ranging nature of all assessed receptors, any barrier or displacement effects would be localised, temporary and reversible. Consequently, cumulative barrier effects from underwater noise are not expected to differ from the WDA-alone and combined assessment and hence not to be significant, and receptors would be able to maintain connectivity between habitats and avoid noisy areas without population-level consequences. With this in mind, the magnitude is assessed as **low**.

10.13.3.2.2.7 Significance of Effect

615. All receptors have been assigned a **medium** sensitivity to barrier effects due to cumulative underwater noise (**Table 10.14**), the magnitude is assessed as **low**, resulting in a **minor adverse** effect, which is **not significant** in EIA terms. For all other phases of the Project, the cumulative effects are expected to be less than during construction.

616. No additional mitigation has been identified as necessary for managing potential cumulative barrier effects due to underwater noise.

10.13.3.2.2.8 Designated Sites

617. As shown in **Table 10.7**, a number of marine mammal designated sites could potentially be affected by barrier effects due to underwater noise in the Wider Study Area. For harbour porpoise, the qualifying populations of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIA. As no significant effects on the WS MU are predicted as a result of barrier effects due to underwater noise, no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

618. For minke whale, a single designated site may potentially be affected by cumulative vessel disturbance and collision risk associated with potential barrier effects arising from underwater noise within the Wider Study Area i.e. the Sea of the Hebrides NCMPA. With respect to cumulative disturbance, no other offshore windfarm EIARs have identified barrier effects on the Sea of the Hebrides NCMPA. Furthermore, the NCMPA-specific minke whale assessment for the WDA alone (as presented in the **Report to Inform the Marine Protected Area Assessment**) concluded that significant barrier effects from underwater noise are not anticipated. Consequently, cumulative barrier effects arising from underwater noise are considered unlikely. On this basis, it is concluded that increased vessel activity would not result in significant effects on the Sea of the Hebrides NCMPA.

619. For pinnipeds, several designated sites may potentially be affected by cumulative barrier effects due to underwater noise. These sites include the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional grey and harbour seal populations assessed within this EIA. As no significant effects on the wider grey seal or harbour seal populations are predicted, no significant effects are anticipated for grey seal or harbour seal at any of these designated sites because of barrier effects due to underwater noise.

10.1.1.3 Cumulative Effect 4: Disturbance at Seal Haul-out Sites

10.13.3.2.2.9 Sensitivity

620. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.2.2.10 Magnitude

621. The sensitivity of both grey and harbour seal to disturbance when hauled out is considered to be **medium**.

622. All designated protected seal haul-out sites within the vicinity of the Project are located more than 10 km from the proposed activities. With the location of other offshore windfarms, the closet being 12.5 km, there is limited scope for cumulative impacts from piling noise at those distances. As the piling noise propagates both in water and air, evidence indicates that the impulsive characteristics of piling noise, including kurtosis, reduce substantially beyond distances of approximately 10 km (Southall et al., 2021). This reduction, together with changes in amplitude and frequency content, substantially limits the potential for disturbance to seals in the water column and results in almost no impact to seals while hauled out. In addition, the distance of at least 12 km between the Project and known haul-out sites means that piling and other noise sources at the Project would not affect seals during sensitive pupping periods for harbour seal (June–August) or grey seal (September–November); therefore, no risk of pup abandonment is anticipated.

623. In a cumulative context, vessel movements associated with the MachairWind Project and other projects have the potential to cause cumulative impacts. However, where practicable, vessels will utilise existing shipping routes and established shipping lanes. Given the proximity of these routes to ports and long-standing marine traffic, seals using nearby haul-out sites are considered likely to be habituated to routine vessel presence and noise. As presented in the WDA-alone assessment (**Section 10.12.1.11**), no matter what ports will be used by the Project, all vessels should be able to maintain at least a 2 km distance from the protected seal haul-out sites, which is likely to be the similar across other projects included in the cumulative assessment. All windfarms, whether in the construction phase or operational phase, are likely to implement industry-standard measures to mitigate any disturbance to hauled out seals, similar to those included in the **Appendix 6 Outline EMP**.

624. Taking into account the spatial separation of projects, the implementation of vessel-management and mitigation measures, the natural attenuation of underwater noise with distance and the temporary and reversible nature of the activities, the magnitude for cumulative disturbance to seal haul-outs is assessed as **low**.

10.13.3.2.2.11 Significance of Effect

625. Given the **medium** sensitivity of both seal species (**Table 10.14**) and the conservative **low** magnitude of cumulative impacts, a **minor adverse** significance of effect for all phases of the Project which is **not significant** in EIA terms, is concluded.

626. No additional mitigation has been identified as necessary for managing potential cumulative disturbance at seal haul-out sites.

10.13.3.2.2.12 Designated Sites

627. As shown in **Table 10.7**, several pinniped designated sites could potentially be affected by disturbance at protected seal haul-out sites, arising from cumulative underwater noise activities and the increase presence of vessels. These sites include the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations qualifying these SACs form part of the wider regional populations assessed within this EIA. As no significant effects on the wider grey or harbour seal populations are predicted, no significant effects are anticipated for grey seal or harbour seal at any of these designated sites as a result of cumulative disturbance at protected seal haul-out sites.

10.1.1.4 Cumulative Effect 5: Changes to Prey Availability

10.13.3.2.2.13 Sensitivity

628. The sensitivity classifications applied to all receptors for each impact considered within the WDA-alone assessment, combined assessment and CEA are presented in **Table 10.14**. Further narrative is provided in **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline Report**.

10.13.3.2.2.14 Magnitude

629. As outlined in **Chapter 9 Fish (including Basking Shark) and Shellfish**, cumulative effects on prey species from underwater noise and vibration, permanent habitat loss, EMF INNS, and changes in fishing activity are assessed as negligible, resulting in **minor adverse** effects overall.

630. Any cumulative change in prey availability is therefore expected to be minor. Disturbance to prey species from underwater noise (including piling) would be similar to, or less than, that experienced directly by marine mammals and leatherback turtle. Where prey displacement occurs, receptors are expected to have already been disturbed from an equal or greater area. No additional cumulative effects via prey availability are therefore anticipated beyond those assessed for direct disturbance.

631. The cumulative increase in EMF from multiple operational cables is not expected to exceed that assessed for the Project, with effects on prey species remaining negligible to minor adverse. EMF levels are considered to be below thresholds associated with physiological harm, with no evidence of injury to marine organisms (Gill and Desender, 2023) and any behavioural responses are expected to be localised, temporary and reversible, with no population-level effects on prey species.

632. Permanent habitat loss from fixed infrastructure is highly localised and represents a very small proportion of the wider available habitat. When considered cumulatively, no meaningful reduction in habitat or prey availability at scales relevant to marine mammals or leatherback turtle is anticipated.

633. Given the limited spatial extent of effects, the broad prey base of receptors and their extensive foraging ranges, there is no credible pathway for cumulative population-level effects arising from changes in prey availability. The cumulative magnitude of impact is assessed as **negligible** to **low**.

10.13.3.2.2.15 Significance of Effect

634. With a **medium** sensitivity assigned to harbour porpoise and mysticetes, and a **low** sensitivity for delphinids, pinnipeds and leatherback turtle (**Table 10.14**), the magnitude is assessed a precautionary **low**, resulting in a **minor adverse** effect for all receptors during all phases of the Project, which is **not significant** in EIA terms.

10.13.3.2.2.16 Designated Sites

635. As shown in **Table 10.7**, several marine mammal designated sites could potentially be affected indirectly by changes to prey availability due to activities in the WDA. For harbour porpoise, the population features of the Inner Hebrides and the Minches SAC and the Skerries and Causeway SAC form part of the WS MU, which is the focus of the harbour porpoise assessment in this EIAR. As no significant effects on the WS MU are predicted from changes in prey availability, no significant effects are anticipated on the harbour porpoise populations supporting either SAC.

636. For minke whale, activities within the WDA are unlikely to result in changes to prey availability within the relevant designated site, the Sea of the Hebrides NCMPA, as prey-mediated pathways were screened out of the NCMPA-specific minke whale assessment presented in the **Report to Inform the Marine Protected Area Assessment**. Therefore, any changes to prey resources within the WDA are not anticipated to result in significant effects on the NCMPA.

637. For pinnipeds, several designated sites may be affected indirectly by changes to prey availability due to activities in the WDA, including the Treshnish Isles SAC (grey seal) and the South-East Islay Skerries, Eileanan agus Sgeiran Lios Mòr, Sound of Barra, and Ascrib, Isay and Dunvegan SACs (harbour seal). The seal populations associated with these SACs form part of the wider regional populations assessed within this EIAR. As no significant effects on the wider grey and harbour seal population are predicted, no significant effects are anticipated for grey and harbour seal at any of these designated sites due to changes in prey availability.

10.13.3.3 Summary of Cumulative Effect of Repeated Disturbance Events

638. A scenario of cumulative disturbance events may be caused by the following:

- Offshore windfarms;
    - Piling events throughout the five-year construction period (has already been assessed using iPCoD modelling (see **Section 10.13.3.1.1**));
    - Construction, O&M, decommissioning activities (other than piling) and operational WTG noise throughout the 35-year lifetime; (has been assessed in **in Section 10.13.3.1.2**); and
    - Presence of vessels throughout the 35-year lifetime (has been assessed in **Section 10.13.3.2**).
- Other industries / activities (such as subsea cables, UXO clearance, geophysical surveys and seismic surveys) (have been assessed in **Cumulative Effect 1c** in **Section 10.13.3.1.3**).

639. Among the disturbance pathways considered, piling is identified as the worst-case scenario for receptors during construction due to the high levels of underwater noise it generates. Other construction activities produce substantially lower noise outputs and are therefore expected to result in proportionally smaller disturbance effects on marine mammal populations.

640. With respect to repeated disturbance arising from multiple concurrent activities, **Section 10.13.3.1** (Cumulative Effect 1) presents a quantitative assessment of the combined effects of overlapping construction programmes at other offshore windfarms, alongside other industry-related noisy activities occurring at the same time as piling at the Project. The assessment provides a snapshot of potential cumulative disturbance; however, the likelihood of these activities occurring simultaneously on the same day is very low, due to vessel constraints, weather, and project schedules. Across the duration of the Project construction period, different activities may take place at various times, meaning any disturbance will be both spatially and temporally dispersed rather than concentrated.

10.13.3.3.1 Seismic Surveys and Geophysical Surveys

641. Long-term effects of non-piling noise sources, including vessel traffic and seismic surveys, remain difficult to quantify, and evidence for biologically meaningful cumulative effects is limited (Gordon et al., 2003). While seismic surveys may cause short-term behavioural disturbance, long-term impacts, particularly from shipping noise, are challenging to detect despite observed recovery following exposure (Wisniewska et al., 2018b; New et al., 2020; Hao et al., 2024).

642. Although chronic noise exposure has the potential to induce physiological stress and disrupt communication and social behaviour (Gordon et al., 2003), empirical evidence indicates such effects are unlikely to manifest at population scales. Thompson et al. (2013) found that harbour porpoise responses to seismic surveys were short-lived, with rapid return to affected areas and evidence of reduced responsiveness over time.

643. Overall, available evidence indicates that disturbance from seismic surveys and other non-piling noise sources is unlikely to result in significant long-term or population-level effects on marine mammals and leatherback turtle.

10.13.3.3.2 UXO Clearance

644. UXO clearance activities are typically single-pulse events with limited potential for prolonged disturbance. A revised joint position statement (UK Government et al., 2025) confirms that low-noise clearance techniques are the default approach for all marine UXO, with high-order detonations permitted only as a last resort under exceptional circumstances and subject to agreement with the licensing authority. Where high-order clearance is authorised, accompanying guidance indicates that noise abatement measures are expected (Marine Directorate, 2025).

645. In light of this updated policy framework, the majority of future UXO clearance is anticipated to employ low-order techniques. Although unmitigated high-order detonation has been assessed as a precautionary worst-case scenario for assessment purposes, it would only occur in the event of an accidental high-order detonation when attempting a low-order clearance and so is highly unlikely to occur.

646. Evidence suggests uncertainty in the relationship between UXO charge size and underwater noise levels, with studies reporting smaller TTS-onset and behavioural disturbance ranges than commonly assumed, and indications that modelling may overestimate noise propagation (Majewska et al., 2025; Lepper et al., 2024).

647. Overall, the available evidence indicates that disturbance from both low- and high-order UXO clearance methods is unlikely to result in significant long-term or population-level impacts on marine mammals and leatherback turtle.

10.13.3.3.3 Offshore Windfarms

10.13.3.3.3.1 Piling

648. Given the current lack of quantitative methods for evaluating long-term disturbance effects, the iPCoD model was applied to simulate population-level changes over time resulting from piling disturbance (**Section 10.13.3.1.1.3** (population modelling)). The model compares disturbed and undisturbed population trajectories for the relevant MU (**Table 10.6**), allowing potential effects to be considered alongside natural environmental variability and demographic stochasticity (Harwood et al., 2014; King et al., 2015).

649. Evidence on the longer-term implications of repeated exposure to noisy activities remains limited, with most studies focusing on harbour porpoise. Nabe-Nielsen et al. (2018) reported that porpoise densities returned to baseline levels within two to six hours following cessation of piling. Similarly, Brandt et al. (2011) found that porpoises typically recovered within 2.5 to 11.5 hours after piling activity stopped.

650. Graham et al. (2019) reported a decreasing response distance of harbour porpoises to piling noise over the course of a piling campaign in the Moray Firth. At the start of the programme, porpoises showed a >50% probability of responding within 24 hours at distances up to 7.4 km, reducing to 4.0 km by the campaign midpoint and 1.3 km by the end. These results indicate quicker recovery and reduced responsiveness over time, consistent with habituation and declining disturbance as piling progressed.

10.13.3.3.3.2 Non-Piling Activities (Construction, O&M, and Decommissioning Phases)

651. Throughout the operational lifetime of the MachairWind Project, maintenance activities will involve vessel use, with the potential for repeated disturbance already assessed under Cumulative Effect 2 (**Section 10.13.3.2**). As outlined there, while individual disturbance events may recur, they are temporary, intermittent and non-continuous, and are not expected to result in long-term or population-level effects on receptors over the operational period.

652. Given that the worst-case scenario of simultaneous piling at multiple projects was assessed as not significant for relevant marine mammal populations that were assessed using the iPCoD, it is reasonable to conclude that other, quieter and/or non-impulsive activities would result in lower levels of disturbance. Lower-intensity activities, such as cable-laying, generate localised and short-lived noise, which is often masked by vessel noise and is unlikely to result in more than minor and brief effects (Taormina et al., 2018).

653. Overall, while some uncertainty remains regarding the long-term effects of non-piling construction activities, the available evidence indicates that disturbance from louder sources such as piling or seismic surveys is unlikely to result in significant long-term impacts. Consequently, lower-intensity activities are not expected to give rise to long-term or population-level effects on receptors.

10.13.3.3.3.3 Operational Wind Turbine Generator Noise

654. Across the 35-year operational life of the Project, there is potential for recurring disturbance to receptors. However, piling and other construction-related noise at all screened-in projects will have ceased during the operational phase, with only operational WTG noise present following commissioning. This effect was assessed qualitatively in **Section 10.13.3.1.2** and was determined to result in a minor adverse effect, which is **not significant** in EIA terms.

655. In addition to the literature referenced and the findings described at **Section 10.12.1.13**, disturbance from operational windfarms is expected to be confined to the boundaries of each windfarm array area (Leemans and Fijn, 2023). As a result, there would be no overlap in operational disturbance footprints between different projects.

656. Furthermore, research demonstrates that marine mammals continue to utilise windfarm areas once operational. Multiple studies have documented the presence, and in some cases active foraging, of species such as harbour porpoise and seals within operational windfarms (e.g. Diederichs et al., 2008b; Lindeboom et al., 2011; Marine Scotland, 2012; McConnell et al., 2012; Russell et al., 2014c; Scheidat et al., 2011; Teilmann et al., 2006b; Tougaard et al., 2005b; Tougaard et al., 2009c; Tougaard et al., 2009d; Leemans and Fijn, 2023). Importantly, operational WTG noise has not been shown to cause disturbance at levels comparable to construction-phase noise.

657. Based on this evidence, operational WTG noise is not expected to cause repeated or sustained disturbance to receptors, as the available data indicate that operational noise has minimal behavioural impact.

10.13.3.3.3.4 Decommissioning

658. The precise timing and methods for decommissioning offshore infrastructure remain uncertain. As a result, the nature and extent of any cumulative disturbance during decommissioning cannot yet be fully predicted. It is reasonable, however, to expect that certain activities, such as cutting operations and increased vessel traffic, could give rise to repeated disturbance. As construction represents the worst-case phase for noise-related impacts, decommissioning effects are assumed to be less than those assessed for construction. On this basis, and informed by noise sources for which detailed project-specific information is available, particularly impact piling at other offshore windfarms in combination with piling at the Project; decommissioning is predicted to result in **minor adverse** effects which is **not significant** in EIA terms for all receptors.

10.13.3.3.4 Precaution within the Cumulative Effects Assessment

659. For the CEA, it is noted that:

- The assessment applied the realistic worst-case impact ranges for all projects and activities without the consideration of embedded or additional mitigation;
- For harbour porpoise and minke whale the highest seasonal density was used taken from 30-month DAS, resulting in a value more than twice that indicated by SCANS-IV (2023);
- Estimated numbers of disturbed mysticetes, delphinids and pinnipeds for the WDA-alone assessment were derived using EDRs and the dose-response curve stemmed from harbour porpoise studies. This is a highly precautionary approach given differences in hearing groups and species sensitivities, likely over-estimating the number of individuals affected;
- Not all individuals within the modelled disturbance range would be displaced;
- Behavioural responses from UXO clearance, where they occur, would be instantaneous and short-lived, and guidance (JNCC, 2025a) indicates that disturbance is not expected if UXO activity is brief; and
- Although repeated disturbances may occur across the Wider Study Area from multiple projects over time, no quantitative methods currently exist to assess long-term, repeated impacts beyond population modelling for piling. The evidence base therefore draws upon a precautionary quantitative approach (including iPCoD) combined with available literature to reach an overall effect of significance conclusion based on professional judgement.

660. This cumulative assessment incorporates information from other relevant projects to the best available knowledge up to the agreed six-month cut-off prior to submission. The final MMMP / Piling Noise Mitigation Plan will provide more detailed mitigation requirements.

10.14 TRANSBOUNDARY EFFECTS

661. The highly mobile nature of marine mammals included within this assessment means that there is the potential for transboundary effects from the Project on marine mammals and leatherback turtle receptors within the EEA, as individuals from other countries may transit to and forage within MachairWind. Therefore, all potential effects as identified in **Sections 10.12** and **10.13** have the potential for transboundary effects.

662. As shown in (e.g.) Plate 5.11 of **Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**, the whole MU for each marine mammal species incorporates international waters where relevant (e.g. the MU for minke whale includes waters across the North Sea, English Channel, and

Celtic and Irish seas, including international waters, as minke whale are to be managed as one population across that entire area). The assessment for the MachairWind Project has however only considered the UK proportion of each of the MUs, as requested by NatureScot. To take transboundary effects into consideration, the entire MU should be considered, as that is the area at which the MachairWind Project may have transboundary effects.

663. As noted above, the marine mammal assessments have been undertaken based on the UK portion of the relevant MU only. For example, for harbour porpoise, this is a population of 24,303 within the WS MU, however, if the entire MU population were to be considered, then the population number itself would be bigger (with a population of 28,936). Therefore, the assessments undertaken are worst-case, and if the entire MU population were to be used within the assessments, the proportion affected (and therefore the magnitudes of impact) would be less than that assessed for MachairWind, either alone or cumulatively with other projects and activities.

664. There is a substantial level of marine development being undertaken, and being planned, by other countries (including the Republic of Ireland) in the wider area. Each of these countries have their own independent environmental assessment requirements and controls. As noted above, marine mammals and leatherback turtles are highly mobile and there is therefore the potential for transboundary effects to their populations, especially with regard to underwater noise. If there is potential for the Project to affect marine mammals and leatherback turtles from other designated sites, this is assessed in the **RIAA** and **Report to Inform MPA Assessment**.

665. As noted above, the assessments provided in this chapter are based on the UK portion of the relevant MUs, rather than the whole MUs. If the whole MU were to be considered for cumulative effects (i.e. transboundary), then while the number of other projects screened into the assessment may increase, so would the overall population numbers those projects are assessed against. Therefore, it is not expected that there would be any change in significance if considered transboundary projects. While there may be additional pressure to the wider population due to higher number of projects, effects would be localised and temporary and therefore not expected to cause significant transboundary effects. The maximum TTS range is 120 km (**Table 10.29**) and the maximum PTS range is 27 km, both for minke whale (**Table 10.23**). The Republic of Ireland is approximately 30 km from the Project, and as noted above, without embedded mitigation, this is potentially in range of TTS effects. However, as discussed in **Section 10.12.1.5.3.2**, this is considered unrealistic due to the propagation characteristics of impulsive noise, with noise from piling not expected to travel further than 10 km in impulsive form. Therefore, any potential for transboundary effect will be outside the Projects ZoI.

10.14.1 Designated Sites

666. As harbour porpoise, minke whale, grey seal and harbour seal present at the Project are part of a larger population (e.g. the WS MU), and there are no significant effects predicted on those populations, there would also be no significant effect on any transboundary designated sites within those same populations. There would also be no effect on any transboundary designated site outside of that population, as no individuals outside of the assessed population is expected to be present at the Project.

10.14.2 Transboundary Effects with Isle of Man

667. As noted above, the highly mobile nature of marine mammals included within this assessment means that there is the potential for transboundary effects from the WDA on marine mammals and leatherback turtle receptors with the IoM. Therefore, all potential effects as identified in **Sections 10.12** and **10.13** have the potential for transboundary effects.

668. Marine Nature Reserves (MNR) in the IoM concerning marine mammals are not covered as part of the **RIAA**. Since the IoM territory is not bound by the regulations outlined in the Habitats Directive (the IoM is not an EEA state, but a self-governing British Crown Dependency), the protected areas within the IoM are not applicable to the scope of the **RIAA**. The potential transboundary effects between the Project and relevant IoM MNRs have therefore been considered here.

669. Unlike for designated sites in the EU and UK, the IoM does not have specific conservation objectives set out for the MNRs but refers to more general objectives such as those of the conservation of specific species or habitats, enabling their recovery and the exclusion of damaging activities and impacts.

670. The potential impacts on designated sites within the IoM are expected to be less than those assessed for the WDA alone; for the combined assessment with the Offshore ECC and the cumulative assessment with other projects.

671. The majority of impacts have a limited ZoI and have areas of effect of approximately 50 km^2, with the exceptions of impact piling and unmitigated high-order UXO clearance. However, due to the highly mobile nature of marine mammals, there is the potential to affect individuals from the MU population which the IoM MNR's support. For the impacts from piling and unmitigated high-order UXO clearance there will be no direct effect on the IoM MNR due to distance, but there is potential of disturbance affecting individuals from the population in the Wider Study Area which could temporarily alter their distribution or range.

672. Assessments for closer designated sites, including the Skerries and Causeway SAC in Northern Ireland, where harbour porpoise is a qualifying feature, have concluded that there would be no adverse effect on site integrity, which was based on the harbour porpoise population level. As the Skerries and Causeway SAC is located at approximately 68 km from the WDA, this represents a more precautionary scenario than the IoM MNRs, which are situated at a substantially greater distance of approximately 230 km. Harbour porpoise is also more susceptible to disturbance from underwater noise than the receptors whose range is supported by the IoM MNR's such as Risso's dolphin and minke whale. Given this increased separation and the correspondingly lower exposure of receptors within the IoM MNRs, it is reasonable to conclude that there would be no adverse effect on the integrity of any IoM MNR's or their qualifying features.

673. All Annex II species considered in the Project assessments are associated with MUs that are different from those relevant to the IoM. The **RIAA** concluded that there would be no adverse effect on the integrity of the relevant SACs assessed. On this basis, it is reasonable to apply the same conclusion to all IoM MNRs in relation to all Annex II species. Therefore, potential effects on Annex II species, including harbour porpoise, grey seal and harbour seal, have been assessed as **not significant**.

674. The MNRs that encompass habitats for Risso's dolphin included Baie ny Carrickey, Calf and Wart Bank, Douglas, and Langness (Table **10.80**). These sites are positioned along the southeast to east coast of the IoM. Both the effects from the WDA alone and the cumulative effects assessed in **Section 10.12**. indicate that Risso's dolphin demonstrated a **minor adverse** to **negligible** effect significance. Looking at the entire population, it was estimated that 7.4% of Risso's dolphin would experience cumulative disturbance during piling if all other offshore windfarms, alongside piling at the WDA, were to occur simultaneously. In contrast, the WDA alone contributed only 0.2% to the disturbed reference population of Risso's dolphin. The number of disturbed animals for all assessed projects was based on the very precautionary approach of using the harbour porpoise dose-response curves and presented unrealistic numbers of disturbed animals. Furthermore, the numbers of disturbed animals are based on the unmitigated noise effect of piling and high-order UXO clearance and as such, the disturbance effect on Risso's dolphin would not cause a significant population level effect on the conservation status of the individuals supported by the MNRs.

675. For minke whale, only one MNR, Laxey, situated on the east coast of the island, has been specifically designated for minke whale (**Table 10.80**). The impacts arising from the WDA alone (**Section 10.12**) exhibited mostly minor adverse effects with embedded mitigation. When assessing cumulative effects detailed in **Section 10.13.3.1**, the impact on minke whale was assessed as **minor adverse** in terms of adverse effect significance. Considering the entire population level (CGNS MU), the cumulative disturbance for this species was estimated to affect less than 10% if all disturbance from piling activities (representing the worst-case) were to occur simultaneously. Regarding long-term predictions concerning population consequences (iPCoD) over a span of 25 years, the effect was also deemed **negligible**. Given the minimal impact observed from the WDA-alone, as well as when considering cumulative effects, the probability of any significant transboundary effects with Laxey MNR would be exceedingly low.

Table 10.80 Summary of IoM MNRs and the potential for transboundary effects

MNR	Distance to the Project	Species	Relevant population	Potential for significant effect on population
Baie ny Carrickey	237 km	Risso's dolphin	CGNS MU	No significant effect on the CGNS MU population of Risso's dolphin, alone or cumulatively with other projects
Calf and Wart Bank	230 km			
Douglas	260 km			
Langness	244 km			
Laxey	267 km	Minke whale	CGNS MU	No significant effect on the CGNS MU population of Risso's dolphin, alone or cumulatively with other projects

676. Overall, underwater noise generated by the MachairWind Project is not predicted to result in any significant adverse effects on regional marine mammal populations within the wider area, including those comprising the full CGNS MU. While receptors occurring in the wider region and surrounding waters form part of shared regional populations, predicted noise levels associated with MachairWind are at a distance great enough for the noise to attenuate substantially into wider areas. As such, any exposure of individuals from the wider CGNS MU and other regional populations would be localised, temporary and below thresholds associated with injury or population-level disturbance.

677. In the context of the size, distribution and connectivity of regional populations, and the absence of sustained or overlapping noise exposure at a transboundary scale, underwater noise from the MachairWind Project is therefore not expected to give rise to significant adverse transboundary effects on regional marine mammal or leather back turtle populations. Based on the Project's assessment for the MUs showing that there is no significant effect on the populations, there is likely to be no transboundary effects on regional/wider populations, as confirmed by the assessments provided through the CEA which include consideration of the wider area.

10.14.3 Summary

678. Considering the minimal impact evident from the WDA alone, along with the assessment of cumulative effects, the likelihood of significant transboundary effects with the IoM MNRs was determined to be low for all receptors given mitigations required by all projects.

10.15 INTER-RELATED AND INTERACTING IMPACTS

10.15.1 Inter-Relationships

679. **Table 10.81** provides a summary of the key inter-relationships between marine mammals and leatherback turtles and other technical chapters and indicates where those issues have been addressed in the relevant chapters.

Table 10.81 Marine mammals and leatherback turtle inter-relationships

Topic and description	Related chapter(s)	Where addressed in this chapter	Rationale
Construction			
Impact 6: Auditory injury and behavioural impacts resulting from vessel noise	Chapter 13 Shipping and Navigation	**Section 10.12.1.8**	Increased vessel traffic could affect the level of disturbance for marine mammals and leatherback turtle.
Impact 8: Vessel Interaction (collision risk)	Chapter 13 Shipping and Navigation	**Section 10.12.1.10**	Increased vessel traffic could affect the level of collision risk for marine mammals and leatherback turtle.
Impact 9: Disturbance at seal haul-out sites	Chapter 13 Shipping and Navigation	**Section 10.12.1.11**	Increased vessel traffic could cause disturbance to protected seal haul-out sites.
Impact 10: Changes to Prey Availability	Chapter 9 Fish (Including Basking Shark) and Shellfish Chapter 8 Benthic Ecology Chapter 12 Commercial Fisheries	**Section 10.12.1.12**	Potential impacts on fish species could affect the prey resource available for marine mammals and leatherback turtle.
Operation and Maintenance			
Impact 6: Auditory injury and behavioural impacts resulting from vessel noise	Chapter 13 Shipping and Navigation	**Section 10.12.1.8**	Increased vessel traffic could affect the level of disturbance for marine mammals and leatherback turtle.
Impact 8: Vessel Interaction (collision risk)	Chapter 13 Shipping and Navigation	**Section 10.12.1.10**	Increased vessel traffic could affect the level of collision risk for marine mammals and leatherback turtle.
Impact 9: Disturbance at seal haul-out sites	Chapter 13 Shipping and Navigation	**Section 10.12.1.11**	Increased vessel traffic could cause disturbance pinnipeds at protected seal haul-out sites.
Impact 10: Changes to Prey Availability	Chapter 9 Fish (Including Basking Shark) and Shellfish Chapter 8 Benthic Ecology Chapter 12 Commercial Fisheries	**Section 10.12.1.12**	Potential impacts on fish species could affect the prey resource available for marine mammals and leatherback turtle.
Decommissioning			

Topic and description	Related chapter(s)	Where addressed in this chapter	Rationale
Inter-relationships for impacts during the decommissioning phase would be the same as those outlined above for the construction phase.			

10.15.2 Interactions

680. The impacts identified and assessed in this chapter have the potential to interact with each other. Areas of potential interaction between impacts are presented in **Table 10.82**. This provides a screening tool for which effects have the potential to interact. **Table 10.82** provides an assessment for each receptor as related to these impacts.

681. The impacts are assessed relative to each development phase (i.e. construction, O&M or decommissioning) to see if multiple effects could increase the significance of the effect upon a receptor.

682. A subsequent lifetime assessment has been undertaken which considers the impact interactions identified and the potential for impacts to affect receptors relevant to this chapter across all development phases (**Table 10.83**).

683. The significance of each individual impact is determined by the sensitivity of the receptor and the magnitude of impact; the sensitivity is constant whereas the magnitude may differ. Therefore, when considering the potential for impacts to be additive it is the magnitude of impact which is important – the magnitudes of the different effects are combined upon the same sensitivity receptor.

Table 10.82 Potential interaction between impacts

Potential Interactions Between Construction, O&M and Decommissioning Impacts											
	Impact 1: Underwater noise during geophysical surveys	**Impact 2: Underwater noise during UXO clearance***	**Impact 3: Auditory injury from underwater noise during piling***	**Impact 4: Behavioural impacts from underwater noise during piling***	**Impact 5: Auditory injury and behavioural impacts resulting from non-piling activities**	**Impact 6: Auditory injury and behavioural impacts from vessel noise**	**Impact 7: Barrier effects due to underwater noise**	**Impact 8: Vessel interaction (collision risk)**	**Impact 9: Disturbance at seal haul-out sites**	**Impact 10: Changes to Prey Availability**	**Impact 11: Underwater noise from operating WTG**
Impact 1: Underwater noise during geophysical surveys		Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Impact 2: Underwater noise during UXO clearance*	Yes		Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Impact 3: Auditory injury from underwater noise during piling*	Yes	Yes		Yes	Yes	Yes	Yes	Yes	No	No	No
Impact 4: Behavioural impacts from underwater noise during piling*	Yes	Yes	Yes		Yes	Yes	Yes	Yes	No	No	No
Impact 5: Auditory injury and behavioural impacts resulting from non-piling noise (other construction activities)	Yes	Yes	Yes	Yes		Yes	Yes	Yes	No	No	Yes
Impact 6: Auditory injury and behavioural impacts resulting from vessel noise	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	No	Yes
Impact 7: Barrier effects from underwater noise	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	No	Yes
Impact 8: Vessel Interaction (collision risk)	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	No	No
Impact 9: Disturbance at seal haul-out sites	No	No	No	No	No	Yes	Yes	Yes		No	No
Impact 10: Changes to Prey Availability	No	No	No	No	No	No	No	No	No		No
Impact 11: Underwater noise from operating WTG	Yes	No	No	No	Yes	Yes	Yes	No	No	No	

**Construction phase only*

Table 10.83 Potential interactions between impacts – phase and lifetime assessment

Potential Interactions Between Impacts					
Receptor	**Construction**	**Operation and Maintenance**	**Decommissioning**	**Phase Assessment**	**Lifetime Assessment**
Harbour porpoise	Major to negligible adverse	Minor to negligible adverse	Assumed no greater than construction	**No greater than individually assessed impact for each phase.** **Construction:** Impact is not greater than individually assessed. The MMMP and Piling Noise Mitigation Plan minimise injury risk (PTS) to marine mammals. During UXO clearance or piling, individuals within range are assumed disturbed and excluded from the injury footprint, removing any interaction between injury and disturbance. Underwater noise from impact piling concluded effects of minor adverse significance and interactions between impacts would not exceed this as the key source of underwater noise is from piling which would only occur during construction. Vessel interaction and prey resource impacts are unlikely to interact with noise effects, as disturbed individuals are excluded from the area. Once noisy activities cease, disturbance and prey changes are highly localised. **O & M:** Impact is not greater than individually assessed. Operational noise and habitat changes are highly localised around WTGs, with negligible	**No greater than individually assessed impact.** The largest impact would occur during the construction phase from piling noise. Once this disturbance ends, any remaining effects during construction and O&M would be small-scale, highly localised, and short-lived. There is no evidence of long-term marine mammal or leatherback turtle displacement from operational offshore windfarms. Therefore, over the operational life of the MachairWind WDA, these impacts are not expected to combine or increase beyond the individually assessed significance.
Delphinids	Minor to negligible adverse	Minor to negligible adverse	Assumed no greater than construction		
Mysticetes	Major to negligible adverse	Moderate to negligible adverse	Assumed no greater than construction		
Pinnipeds	Major to negligible adverse	Moderate to negligible adverse	Assumed no greater than construction		
Leatherback turtle	Minor to negligible adverse	Minor to negligible adverse	Assumed no greater than construction		

Potential Interactions Between Impacts					
				magnitude and no overlapping footprints. O&M noise and vessel interaction are episodic and negligible. Any underwater noise or changes in prey effects during O&M are localised, temporary, and negligible. **Decommissioning:** Impact is not greater than individually assessed. Although removal methods are unknown, effects are expected to be similar to construction (excluding piling).	

10.15.3 Lifetime Assessment

10.15.3.1 Piling

684. For the WDA alone and cumulatively, the highest levels of disturbance are expected during the construction phase, primarily due to piling. These effects would be intermittent, with lower-level but more continuous disturbance arising from other construction activities and increased vessel presence. This additional disturbance is not expected to result in effects of greater significance than those assessed for piling, which represents the worst-case scenario.

685. With the implementation of embedded mitigation measures (as outlined in **Section 10.10**), the overall significance of effect for the WDA alone and cumulatively during construction is assessed as **minor adverse** or **negligible adverse**, and therefore **not significant** in EIA terms.

686. During the decommissioning phase, potential effects on receptors are anticipated to be similar to, or lower than, those assessed under the worst-case construction scenario, reflecting the absence of piling (and UXO clearance). Decommissioning is therefore expected to result in effects of an equivalent or lower magnitude than construction.

687. During the 35-year O&M phase, disturbance events would generally be shorter in duration and more intermittent than during construction, although they would occur repeatedly over time. Overall, the significance of effect for the WDA alone and cumulatively during O&M is assessed as **minor adverse**, and therefore **not significant** in EIA terms.

688. Quantitative assessments undertaken for each project phase provide a snapshot of the number of animals potentially disturbed and the proportion of the relevant reference population affected at a given point in time. These outputs have informed the determination of impact magnitude and effect significance across the Project lifetime, with consideration also given to the duration, frequency, and recoverability of effects. Disturbance effects are considered temporary and reversible, and repeated disturbance is not expected to result in sustained population-level effects for UK or wider reference populations. However, recovery potential may be reduced where disturbance events occur in close

temporal succession, during which animals may incur energetic costs (e.g. Williams et al., 2006; Hastie et al., 2021; Frankish et al., 2023).

689. Cumulatively, multiple projects and activities may affect reference populations either concurrently or sequentially alongside Project activities. However, construction of the WDA concurrent with the operation or decommissioning of other offshore wind farms is not expected to result in additive effects beyond those assessed for the Project under construction. This conclusion also applies to the O&M and decommissioning phases, during which Project-related disturbance levels are lower.

690. This assessment reflects the limited potential for population-level disturbance from individual projects, the spatial separation between developments, and the expectation that appropriate mitigation measures would be implemented across all projects. As such, the potential magnitude of impact arising from overlapping project phases is not expected to exceed the worst-case construction scenario assessed for the Project, and no significant additive effects are anticipated.

691. Taking account of the overall evidence base, the significance of effect across the Project lifetime, both alone and cumulatively, is assessed as **minor adverse** and **not significant** in EIA terms. This conclusion is considered appropriate and proportionate in the context of the MUs assessed for marine mammals and leatherback turtle.

10.15.3.2 Vessels

692. Vessels will be used throughout all phases of the Project and, as such, elevated underwater sound from vessel activity could result in additional disturbance to marine mammals and leatherback turtle when considered over the Project lifetime, compared with assessing each phase in isolation. However, across all phases, vessel activity will primarily be confined to the WDA or Offshore ECC and undertaken at reduced speeds. In addition, vessels will adhere to good-practice measures to minimise disturbance to marine mammals, as secured through **Appendix 6 Outline EMP**. Taking these factors into account, vessel-related effects are not expected to interact across phases in a manner that would result in combined effects of greater significance than those identified for each individual phase.

693. Vessels will be used throughout all phases of other windfarms and, as such, elevated underwater sound from vessel activity could contribute to additional disturbance to marine mammals and leatherback turtle when considered cumulatively across the Project lifetime. However, vessel movements associated with the other projects' windfarm sites and cable corridors, will primarily be enroute to and within those sites and undertaken at reduced speeds. Secured mitigation would also be incorporated into the windfarms' consent licence/applications which would also reduce impacts to receptors. Taking these measures into account, effects on marine mammal and leatherback turtle receptors are not anticipated to interact across phases in a way that would result in cumulative effects of greater significance than those assessed for each individual phase.

10.15.3.3 Additive effects of multiple pathways of disturbance

694. Activities such as geophysical surveys, dredging and UXO clearance are associated with some uncertainty regarding their timing and duration. However, these activities are unlikely to occur simultaneously, as the Project will programme them to take place at different stages of the works. Furthermore, any such activities would be subject to separate licensing processes (where relevant), which would take account of the Project's consented activities and apply appropriate mitigation where necessary.

695. It is not anticipated that the overall significance of cumulative impacts would exceed those assessed individually. While certain activities such as seismic surveys and UXO detonations may extend the

duration of elevated underwater noise across the area and may occur independently of piling, the spatial extent of the most significant disturbance; namely piling would remain limited to the maximum disturbance ranges identified for each receptor. Following completion of piling, non-piling construction and O&M activities would be more localised to the WDA and would be intermittent over the Project lifetime. As such, impacts over time are not expected to exceed the significance of individual effects assessed in isolation.

696. Marine mammals and leatherback turtle are expected to respond primarily to the loudest noise source, which would result in displacement from areas of highest ensonification. As piling represents the worst-case disturbance activity, any additive contribution from quieter, concurrent activities is likely to occur within areas that receptors have already vacated. Temporally, receptors may return to the area between sound-generating activities, resulting in repeated exposure; however, given the intervals between activities, this is not anticipated to result in effects of greater significance than those associated with individual impacts considered alone.

697. With implementation of the MMMP and adherence to the Piling Noise Mitigation Plan, PTS is not predicted to occur for any receptor, and any potential TTS effects are considered recoverable. With respect to disturbance, spatially inter-related effects are considered limited, as disturbance ranges are dictated by the loudest sound sources, reducing the likelihood of secondary additive effects from activities with smaller disturbance ranges.

698. Across the Project lifetime, effects on receptors; including when considered cumulatively with other projects are not expected to interact in a manner that would result in effects of greater significance than those assessed for individual Project phases.

699. At the UK and wider MU scale, cumulative disturbance may occur through repeated noise exposure over time. While this has the potential to increase energetic costs for individual receptors, such effects are expected to be localised to source areas. Given the size of the MUs and reference populations, these effects are not anticipated to alter the overall significance conclusions presented in the cumulative assessment (see **Section 10.13.3**). This conclusion takes into account the mitigation measures proposed for the Project and other developments, while recognising the potential for spatially and temporally repeated disturbance events.

10.16 SUMMARY

700. **Table 10.84** presents a summary of the assessment of potential effects on marine mammals and leatherback turtle during the construction, O&M and decommissioning phases of the Project.

701. For the WDA alone assessment, major adverse effects were initially identified for disturbance from underwater noise for bottlenose dolphin (CWSH MU) and killer whale (WCC). However, considering the full evidence base and taking into account the very low numbers of individuals in each population, causing an inflated scale effect, the significance of effect was reassessed as **minor adverse**, which is **not significant** in EIA terms (**Table 10.84**).

702. Significant effects were initially identified for PTS resulting from piling for harbour porpoise, minke whale, fin whale and humpback whale. However, with the implementation of embedded mitigation measures (**Section 10.10**), and with the 27 km impact being over precautionary due to the level of impulsiveness decreasing after 10 km (Southall et al., 2021); the significance of effect is assessed as **minor adverse**, which is **not significant** in EIA terms.

703. For TTS associated with piling, the magnitude of impact for minke whale was assessed as high. Although the worst-case predicted TTS impact range for low-frequency cetaceans extends up to 120 km, this range is considered overly precautionary and unlikely to occur in reality. Taking this into

account, and considering the full evidence base, the significance of effect is therefore assessed as **minor adverse**, which is **not significant** in EIA terms.

Table 10.84 Summary of potential effects for marine mammals and leatherback turtle

Potential Impact	Impact	Receptor(s)	Relevant Embedded Mitigation Measures	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Proposed Monitoring	Combined Assessment	Cumulative Residual Significance of Effect
Construction											
Impact 1: Underwater noise during geophysical surveys	PTS	Harbour porpoise, bottlenose dolphin (CWSH MU), minke whale	M-12	High	Low	Not Significant (Minor adverse)	N/A	Not Significant		Not Significant	Not Significant (Negligible -Minor adverse)
		All other receptors		High	Negligible						
	Disturbance	Bottlenose dolphin (CWSH MU)		Medium	High	Not Significant (Minor adverse)	N/A	Not Significant		Not Significant	Not Significant (Negligible -Minor adverse)
		Killer whale (WCC) and grey seal (wider population)			Low						
		All other receptors		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant			
Impact 2: Underwater noise during UXO clearance	See **Appendix 10.6 Unexploded Ordnance Clearance Assessment**										
Impact 3a: Auditory injury (PTS) from underwater noise during piling	Instantaneous PTS	All receptors	M-6	High	Negligible	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	N/A	Not Significant (Negligible -Minor adverse)
	Cumulative PTS	Minke whale		High	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	N/A	Not Significant (Negligible -Minor adverse)
		Harbour porpoise, fin whale and humpback whale		High	Medium						
		All other receptors			Negligible						
Impact 3b: Auditory injury (TTS) from underwater noise during piling	Instantaneous TTS	All receptors		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A	N/A	N/A
	Cumulative TTS	Minke whale		Medium	High	Not Significant (Minor adverse)		Not Significant (Minor adverse)		N/A	N/A
		Harbour porpoise, grey seal (WS MU)			Medium						
		Grey seal (wider MU)			Low						
		All other receptors			Negligible	Not Significant (Negligible adverse)		Not Significant (Negligible adverse)		N/A	N/A
Impact 4: Behavioural impacts from underwater noise during piling	Disturbance	Harbour porpoise, bottlenose dolphin, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin killer whale (WCC), minke whale and grey seal	M-6	Medium	High to low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	N/A	Not Significant (Negligible -Minor adverse)
		All other receptors			Negligible	Not Significant (Negligible adverse)		Not Significant (Negligible adverse)		N/A	
Impact 5: Auditory injury and behavioural impacts resulting from non-piling noise (other construction activities)	PTS	All receptors	M-4; M-47	High	Negligible	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	N/A
	TTS	All receptors		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)		Not Significant	N/A

Potential Impact	Impact	Receptor(s)	Relevant Embedded Mitigation Measures	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Proposed Monitoring	Combined Assessment	Cumulative Residual Significance of Effect
	Disturbance	Bottlenose dolphin (CWSH), killer whale (WCC)		Medium	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse)
		Harbour porpoise, bottlenose dolphin (OW), common dolphin, fin whale, humpback whale and grey seal		Medium	Low						
		All other receptors		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
Impact 6: Auditory injury and behavioural impacts resulting from vessel noise	TTS	Harbour porpoise	M-4; M-47	Medium	Low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	N/A
		All other receptors		Negligible	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		N/A
	Disturbance from vessels in the WDA (maximum 117)	Bottlenose dolphin (CWSH MU), killer whale (WCC)		Low	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse)
		Harbour porpoise		Medium	Low						
		Bottlenose dolphin (OW MU), common dolphin, grey seal and harbour seal		Low	Low						
		Minke whale, fin and humpback whale		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
		All other receptors		Low	Negligible						
	Disturbance from transiting vessels	Bottlenose dolphin (CWSH MU), killer whale (WCC) and grey seal (WS MU)		Low	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse)
		Bottlenose dolphin (OW MU)		Low	Medium						
		Harbour porpoise and minke whale		Medium	Low						
		Common dolphin, white-beaked dolphin and grey seal (WS MU)		Low	Low						
		Fin and humpback whale		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
		All other receptors		Low	Negligible						
Impact 7: Barrier effects from underwater noise	N/A	All receptors	M-4; M-6; M-11; M-12	Medium	Low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
Impact 8: Vessel Interaction (collision risk)	N/A	Harbour porpoise and mysticetes	M-4; M-47	Medium	Low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
		Delphinids, pinnipeds and leatherback turtle		Low	Low					Not Significant	Minor adverse
Impact 9: Disturbance at seal haul-out sites	N/A	Grey and harbour seal	M-4; M-47	Medium	Negligible	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
Impact 10: Changes to Prey Availability	N/A	Harbour porpoise and mysticetes	M-4; M-7; M-8; M-11; M-47	Medium	Negligible to Low		N/A		N/A	Not Significant	

Potential Impact	Impact	Receptor(s)	Relevant Embedded Mitigation Measures	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Proposed Monitoring	Combined Assessment	Cumulative Residual Significance of Effect
		Delphinids, pinnipeds and leatherback turtle		Low	Negligible to Low	Not Significant (Negligible to Minor adverse)		Not Significant (Negligible to Minor adverse)			Not Significant (Negligible -Minor adverse
Operation and Maintenance											
Impact 1: Underwater noise during geophysical surveys	See construction										
Impact 5: Auditory injury and behavioural impacts resulting from non-piling noise (O&M activities)	PTS	All receptors	See construction	High	Negligible	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	N/A
	TTS	Harbour porpoise, bottlenose dolphin (CWSH MU), killer whale (WCC), minke whale and grey seal (WS MU)		Medium	Low					Not Significant	
		All other receptors			Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A	Not Significant	
	Disturbance	Bottlenose dolphin (CWSH MU), killer whale (WCC)		Medium	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse
		Bottlenose dolphin (OW MU), grey seal (WS MU)			Medium						
		Harbour porpoise, common dolphin, Atlantic white-sided dolphin, white-beaked dolphin, minke whale, grey seal (wider MU) and harbour seal			Low						
		All other receptors			Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
Impact 6: Auditory injury and behavioural impacts resulting from vessel noise	TTS	Harbour porpoise	See construction	Medium	Medium	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	N/A
		Bottlenose dolphin (CWSH MU), killer whale (WCC), minke whale and grey seal (WS MU)		Medium	Low	Not Significant (Minor adverse)					
		All other receptors		Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
	Disturbance from vessels in the WDA (maximum 13)	Bottlenose dolphin (CWSH MU), killer whale (WCC) and grey seal (WS MU)		Low	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse
		Harbour porpoise and minke whale		Medium	Medium						
		White-beaked dolphin and grey seal (wider population)		Low	Medium						

Potential Impact	Impact	Receptor(s)	Relevant Embedded Mitigation Measures	Sensitivity	Magnitude of Impact	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Proposed Monitoring	Combined Assessment	Cumulative Residual Significance of Effect
		Fin and humpback whale		Medium	Low						
		Killer whale (NA)		Low	Negligible	Not significant (Negligible adverse)					
		All other receptors		Low	Low	Not Significant (Minor adverse)	N/A	Not Significant (Negligible adverse)	N/A		
	Disturbance from transiting vessels	Bottlenose dolphin (CWSH MU & OW MU), killer whale (WCC) and grey seal (WS MU)		Low	High	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse
		Harbour porpoise and minke whale		Medium	Medium						
		Fin and humpback whale		Medium	Low						
		All other receptors		Low	Low	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
Impact 7: Barrier effects from underwater noise		All receptors	M-4	Medium	Low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
Impact 8: Vessel Interaction (collision risk)		Harbour porpoise and mysticetes	M-4	Medium	Low	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
		Delphinids, pinnipeds and leatherback turtle		Low	Low	Not Significant (Minor adverse)		Not Significant (Minor adverse)		Not Significant	Not Significant (Minor adverse)
Impact 9: Disturbance at seal haul-out sites		Grey and harbour seal	M-4	Medium	Negligible	Not Significant (Minor adverse)	N/A	Not Significant (Minor adverse)	N/A	Not Significant	Not Significant (Minor adverse)
Impact 10: Changes to Prey Availability		Harbour porpoise and mysticetes	M-4	Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A	Not Significant	Not Significant (Negligible -Minor adverse
		Delphinids, pinnipeds and leatherback turtle		Low	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A		
Impact 11: Underwater noise from operating WTG	TTS	All receptors	N/A	Medium	Negligible	Not Significant (Negligible adverse)	N/A	Not Significant (Negligible adverse)	N/A	N/A	Negligible adverse
	Disturbance			Low	Negligible				N/A	N/A	Minor adverse
Decommissioning											
Impacts during the decommissioning phase will be similar or less than the construction phase (see construction)											

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