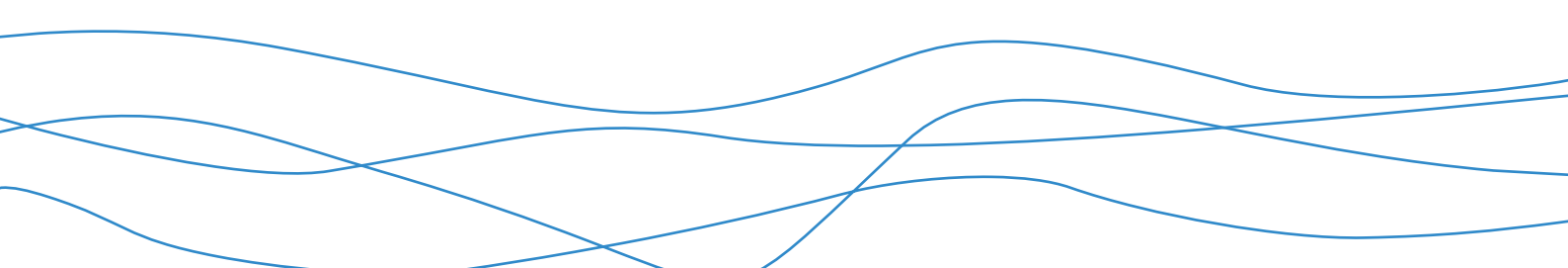




Bowdun Offshore Wind Farm, Offshore EIA Report

Volume 2, Chapter 10: Marine Mammals

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Contents

10	Marine Mammals	1
10.1	Introduction	1
10.2	Marine Mammals Study Area	1
10.3	Legislative and Policy Context.....	5
10.4	Consultation	11
10.5	Data Sources	23
10.6	Baseline Environment	27
10.7	Key Parameters for Assessment.....	39
10.8	Methodology for Assessment of Effects.....	50
10.9	Embedded Mitigation	67
10.10	Assessment of Significance	74
10.11	Inter-Related Effects.....	172
10.12	Cumulative Effects Assessment	180
10.13	Proposed Monitoring	266
10.14	Summary of Impacts, Mitigation, Likely Significant Environmental Effects and Monitoring	266
	References	275

List of Tables

Table 10.1: Summary of Marine (Scotland) Act 2010 Relevant to Marine Mammals	5
Table 10.2: Summary of Habitats Regulations Relevant to Marine Mammals.....	5
Table 10.3: Summary of the Nature Conservation (Scotland) Act 2004 Relevant to Marine Mammals	6
Table 10.4: Summary of Scotland’s National Marine Plan (2015) Relevant to Marine Mammals	6
Table 10.5: Summary of PMF in Scotland’s Seas - Habitats Relevant to Marine Mammals (NatureScot, 2020)	8
Table 10.6: Summary of The Sectoral Marine Plan for Offshore Wind Energy 2020 Relevant to Marine Mammals	8
Table 10.7: Summary of The United Kingdom (UK) Marine Policy Statement Relevant to Marine Mammals	9
Table 10.8: Summary of The Scottish Biodiversity Strategy (Scottish Government, 2023) Relevant to Marine Mammals	10
Table 10.9: Summary of the Marine Strategy Framework Directive (Directive 2008/56/EC) 2008, Relevant to Marine Mammals	10
Table 10.10: Summary of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) 1992, Relevant to Marine Mammals	10
Table 10.11: Summary of the Protection of Seals (Designation of Seal haul-Out Sites) (Scotland) Order 2014, Relevant to Marine Mammals	11
Table 10.12: Summary of Key Consultation Issues Raised During Consultation Activities Undertaken for the Proposed Development Relevant to Marine Mammals	12
Table 10.13: Summary of Key Data Sources Reviewed	23
Table 10.14: Summary of Site-Specific Survey Data.....	26
Table 10.15: Summary of Marine Mammal Receptors to be Considered Quantitatively Together with Relevant Densities, and Reference Populations	31
Table 10.16: Designated Sites and Relevant Qualifying Features for Marine Mammals Within the Regional Marine Mammal Study Area.....	32
Table 10.17: IEFs Within the Proposed Development Marine Mammal Study Area	34
Table 10.18: Summary of the Conservation Status of each Marine Mammal Species (FV = Favourable, XX = Unknown, + = Improving, U1 = Unfavourable – Inadequate, S = Stable, NA = Not Available)	38
Table 10.19: Maximum Design Scenario Considered for Each Potential Impact as Part of the Assessment of Likely Significant Environmental Effects on Marine Mammals	40
Table 10.20: Impacts Scoped Out of the Assessment for Marine Mammals (Tick Confirms the Impact is Scoped Out)	48
Table 10.21: Definition of Terms Relating to Magnitude of Impact	52
Table 10.22: Definition of Terms Relating to the Sensitivity of the Receptor	54
Table 10.23: Matrix Used for the Assessment of the Significance of the Effect	55
Table 10.24: Definition of Significance	56
Table 10.25: Marine Mammal Hearing Groups with their Generalised Hearing Ranges (NMFS, 2024)	58
Table 10.26: Summary of Acoustic Terminology.....	58
Table 10.27: Summary of TTS and Auditory Injury Acoustic Thresholds (NMFS, 2024).....	58
Table 10.28: Assessment Swim Speeds of Marine Mammals that are Likely to Occur Within the North Sea for the Purposes of Exposure Modelling	59
Table 10.29: Summary of Disturbance Criteria Used in the Assessment.....	60
Table 10.30: Embedded Mitigation Adopted as Part of the Proposed Development	68
Table 10.31: Impact Piling Schedule Used in the Assessment - Monopile Wind Turbine Foundations	75
Table 10.32: Impact Piling Schedule Used in the Assessment – Jacket Wind Turbine Foundations (including OSPs).....	75
Table 10.33: Impact Piling Schedule Used in the Assessment - Monopile Wind Turbine Foundations, Realistic Installation Scenario	76
Table 10.34: MU and Population Estimates for Species Included in iPCoD Models	78
Table 10.35: Marine Mammal Vital Rates Used to Parameterise iPCoD Models (from Sinclair <i>et al.</i> (2020))	78
Table 10.36: Potential Marine Mammal Injury Ranges for Pile Installation of Monopile Foundations, Based on the NMFS (2024) peak SPL Metric (N/E – Threshold Not Exceeded).....	80

Table 10.37: Potential Marine Mammal Injury Ranges for Pile Installation of Jacket Piles, Based on the NMFS (2024) peak SPL Metric (N/E – Threshold Not Exceeded).....	80
Table 10.38: Potential Marine Mammal Injury Ranges for Realistic Pile Installation of Monopile Foundations, Based on the NMFS (2024) peak SEL Metric (N/E – Threshold Not Exceeded).....	80
Table 10.39: Potential Marine Mammal Injury Ranges for Single Pile Installation Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)	81
Table 10.40: Potential Marine Mammal Injury Ranges for Single Pile Installation of Jacket Piles, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded).....	81
Table 10.41: Potential Marine Mammal Injury Ranges for the Realistic Single Pile Installation of Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded).....	81
Table 10.42: Potential Marine Mammal Injury Ranges for Concurrent Pile Installation Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded).....	82
Table 10.43: Potential Marine Mammal Injury Ranges for Concurrent Pile Installation of Jacket Piles, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded).....	82
Table 10.44: Potential Marine Mammal Injury Ranges for the Concurrent Realistic Pile Installation of Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded).....	83
Table 10.45: Numbers of Animals at Risk of Auditory Injury Using the Auditory Injury Peak SPL, Together with the Percentage of Management Unit Population Potentially Affected (N/A = Not Available).....	83
Table 10.46: Numbers of Animals at Risk of Auditory Injury Using the SEL _{cum} no ADD, together with the Percentage of Management Unit Population Potentially Affected.....	84
Table 10.47: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Graham <i>et al.</i> , 2017), and the Percentage of the Population at Risk at both the Full MU and the UK Portion of the MU for the Maximum Spatial Scenario (Monopile Foundation).....	90
Table 10.48: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Graham <i>et al.</i> , 2017), and the Percentage of the Population at Risk at both the Full MU and the UK Portion of the MU for the Maximum Temporal Scenario (Jacket Foundation Pile).....	90
Table 10.49: The Number of Animals at Risk of Disturbance Using the Mild and Strong Disturbance Metrics (140 dB _{rms} and 160 dB _{rms} Respectively), and the Resulting Percentage of the Population at Risk Using the UK Portion of the MU for MDS (Monopile Foundation).....	91
Table 10.50: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Whyte <i>et al.</i> , 2020), and the Resulting Percentage of the Population at Risk Using the SMU Reference Populations from the North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU Combined for Grey Seal, and the Moray Firth SMU and the East Scotland SMU Combined for Harbour Seal for Maximum Spatial Scenario (Monopile Foundation).....	91
Table 10.51: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Whyte <i>et al.</i> , 2020), and the Resulting Percentage of the Population at Risk Using the SMU Reference Populations from the North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU Combined for Grey Seal, and the Moray Firth SMU and the East Scotland SMU Combined for Harbour Seal Maximum Temporal Scenario (Jacket Foundation Pile).....	91
Table 10.52: Details of UXO and their Relevant Charge Sizes Employed for Modelling.....	120
Table 10.53: Maximum Potential AUD INJ Ranges for Low order Clearance and High order Clearance (N/E = Threshold Not Exceeded) (NMFS, 2024).....	122
Table 10.54: Maximum Potential Number of Animals with the Potential to Experience Auditory Injury Due to Low order Clearance and High order Clearance (N/E = Threshold Not Exceeded)...	122
Table 10.55: UXO Clearance Application of ADD Mitigation.....	125
Table 10.56: Maximum Potential TTS Ranges for Low order and High Order Clearance.....	127
Table 10.57: Maximum Potential Number of Animals With the Potential to Experience TTS Onset Due to Low order Clearance and High order Clearance.....	128
Table 10.58: Potential Injury (AUD INJ) Impact Ranges (m) for Geophysical Site-Investigation Surveys (N/E = Threshold Not Exceeded).....	134
Table 10.59: Estimated Number of Animals with the Potential to Experience AUD INJ During Geophysical Site-Investigation Surveys (N/E = Threshold Not Exceeded).....	135
Table 10.60: Potential Disturbance Ranges for Geophysical and Geotechnical Site-Investigation Surveys.....	136
Table 10.61: Estimated Number of Animals with the Potential to be Disturbed During Geophysical and Geotechnical Site-Investigation Surveys.....	137

Table 10.62: Estimated Potential Disturbance Ranges from Different Vessels and Other Activities for All Marine Mammals (N/E= Threshold Not Exceeded).....	147
Table 10.63: Maximum Number of Animals with the Potential to Experience Disturbance Due to Vessel Use and Other Subsea Noise producing Activities.....	148
Table 10.64: Summary of Likely Significant Inter-Related Effects for Marine Mammals from Individual Effects Occurring Across the Construction, O&M and Decommissioning Phase of the Proposed Development (Project Lifetime Effects) and from Multiple Effects Interacting Across all Phases (Receptor-led Effects).....	174
Table 10.65: List of Other Projects Considered Within the CEA for Marine Mammals	182
Table 10.66: MDS Considered for Each Impact as Part of the Assessment of Likely Significant Cumulative Effects on Marine Mammals	192
Table 10.67: Wind Turbine Piling Parameters Incorporated into the MDSs of the Tier 2 Projects ..	199
Table 10.68: OSP Piling Parameters Incorporated into the MDSs of the Tier 2 Projects	200
Table 10.69: Harbour Porpoise Number of Animals Disturbed for the CEA as a Result of Subsea Noise Generated During Piling.....	204
Table 10.70: Bottlenose Dolphin Number of Animals Disturbed for the CEA as a Result of Subsea Noise Generated During Piling.....	210
Table 10.71: White-beaked Dolphin Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling	216
Table 10.72: Minke Whale Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling.....	220
Table 10.73: Grey Seal Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling.....	225
Table 10.74: Harbour Seal Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling.....	230
Table 10.75: UXO Clearance Parameters Incorporated into the MDSs of the Tier 2 Projects.....	236
Table 10.76: Maximum Number of Animals with the Potential to Experience Auditory Injury Due to UXO Clearance for the Tier 2 Projects	238
Table 10.77: Maximum Number of Animals with the Potential to Experience Behavioural Disturbance (TTS) due to UXO Clearance for the Tier 2 Projects	242
Table 10.78: Disturbance Ranges for Marine Mammals During the Geotechnical Site-Investigation Surveys for the Project Development and Tier 2 Projects	248
Table 10.79: Number of Animals with the Potential to be Disturbed During Geophysical and Geotechnical Site-Investigation Surveys for the Project Development and Tier 2 Projects	248
Table 10.80: Summary of Assessment of Significance	268
Table 10.81: Summary of Cumulative Effects Assessment.....	272

List of Figures

Figure 10.1: Marine Mammal Study Areas.....	3
Figure 10.2: Relevant Marine Mammal MUs and Study Areas.....	4
Figure 10.3: Marine Mammal Relevant Designated Sites	33
Figure 10.4: Relationship Between the Proportion of Harbour Porpoise Responding and the Received Single Strike SEL (SEL _{ss}) Graham <i>et al.</i> (2017).....	62
Figure 10.5: The Probability of a Harbour Porpoise Response (24 Hr) in Relation to the Unweighted Received Single-Pulse SEL for the First Location Piled (Blue Line), the Middle Location (Orange Line) and the Final Location Piled (Grey Line). Reproduced From Graham <i>et al.</i> (2019)	62
Figure 10.6: Predicted Decrease in Seal Density as a Function of Estimated Sound Exposure Level, Error Bars Show 95% CI (from Whyte <i>et al.</i> , 2020).....	64
Figure 10.7: Unweighted SEL _{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North location with Monopile Foundation (6,250 kJ) at the South Location, Harbour Porpoise Density and Designated Sites	93
Figure 10.8: Simulated Harbour Porpoise Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Installation Scenario (Maximum Temporal Scenario)	95
Figure 10.9: Simulated Harbour Porpoise Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation Scenario (Maximum Spatial Scenario).....	96

Figure 10.10: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Bottlenose Dolphin Density Surface from Gilles *et al.* (2025) and Designated Sites..... 98

Figure 10.11: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario Using the Coastal East Scotland MU Vital Rates) 100

Figure 10.12: Simulated Bottlenose Dolphin Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario Using the Coastal East Scotland MU Vital Rates)..... 100

Figure 10.13: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario Using the GNS MU Vital Rates) 101

Figure 10.14: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario Using the GNS MU Vital Rates) 101

Figure 10.15: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, White-beaked Dolphin Density Surface from Gilles *et al.* (2025) and Designated Sites 103

Figure 10.16: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Minke Whale Density and Designated Sites..... 105

Figure 10.17: Simulated Minke Whale Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario) 106

Figure 10.18: Simulated Minke Whale Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario)..... 107

Figure 10.19: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Grey Seal Density and Designated Sites 109

Figure 10.20: Simulated Grey Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Floating and OSP Installation (Maximum Temporal Scenario) 110

Figure 10.21: Simulated Grey Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Floating and OSP Installation (Maximum Concurrent Scenario)..... 111

Figure 10.22: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Harbour Seal Density and Designated Sites 113

Figure 10.23: Simulated Harbour Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation 114

Figure 10.24: Simulated Harbour Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation..... 115

Figure 10.25: Vessel Traffic Density (September 2023 to August 2024) in the Shipping and Navigation Study Area, from Volume 3, Technical Appendix 14.1: Shipping and Navigation Navigational Risk Assessment 144

Figure 10.26: Projects Screened into the CEA for Marine Mammals..... 188

Figure 10.27: Simulated Harbour Porpoise Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario 207

Figure 10.28: Simulated Harbour Porpoise Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario Excluding Bowdun OWF 208

Figure 10.29: Simulated Bottlenose Dolphin Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario (Coastal East Scotland MU Vital Rates)..... 213

Figure 10.30: Simulated Bottlenose Dolphin Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario (GNS MU Vital Rates)..... 214

Figure 10.31: Simulated Minke Whale Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario 223

Figure 10.32: Simulated Grey Seal Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario 228

Figure 10.33: Simulated Harbour Seal Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario 233

Glossary

Defined Term	Definition
Additional Mitigation	Also referred to as secondary mitigation which is defined by The Institute of Sustainability and Environmental Professionals (ISEP) (formerly Institute of Environmental Management and Assessment (IEMA)) as: Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the Environmental Impact Assessment Report (sic).
Annex I	Habitats of community interest whose conservation requires the designation of Special Areas of Conservation (SACs), as identified in Annex I of the Habitats Directive (Council Directive 92/43/EEC).
Annex II	Species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs) as identified in Annex II of Habitats Directive (Council Directive 92/43/EEC).
Anthropogenic	An activity resulting from or relating to the influence of humans.
Applicant (the)	Bowdun Offshore Wind Farm Limited (BOWFL).
Appropriate Assessment (AA)	An assessment to determine the implications of a plan or project for a European site in view of that site's conservation objectives. An Appropriate Assessment forms part of the Habitats Regulations Appraisal (HRA) and is required when a plan or project (either alone or in combination with other plans or projects) is likely to have a significant adverse effect on a European site.
Array Area	The Array Area is the area in which the Offshore Generation Assets will be located.
Benthic	Living on or in the seabed.
Bowdun Offshore Wind Farm Limited (BOWFL)	A Special-Purpose Vehicle (SPV) (legal entity) for the purpose of developing the Project. BOWFL are the Applicant for the Offshore Application.
Cetacean	Marine mammals that are entirely aquatic. These include whales, dolphins, and porpoises.
Crown Estate Scotland (CES)	Public corporation accountable to Scottish Government, responsible for the management of land and property, including marine assets in Scotland owned by the monarch.
Cumulative Effects	The effects of the Proposed Development assessed together with effects from the Onshore Infrastructure forming the Project as well as one or more different projects on the same receptor/resource.
Digital Aerial Surveys (DAS)	A method for undertaking baseline ornithological and marine mammal data collection surveys. Usually undertaken over a period of 24 months.
Effect	Term used to express the consequence of an impact i.e. the result of change or changes on specific environmental resources or receptors. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity of the receptor or resource in accordance with defined significance criteria.

Defined Term	Definition
Embedded Mitigation	<p>Measures that are adopted as part of the Proposed Development and therefore assessed within the EIA. The proposed approach for the EIA for the Proposed Development is that Embedded Mitigation includes both primary mitigation and tertiary mitigation. These are defined by the ISEP as follows:</p> <p>Primary: Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken.</p> <p>Tertiary: Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.</p>
Environmental Impact Assessment (EIA)	<p>Process for the assessment of likely significant environmental effects of a project on the physical, biological, and human environment during construction, Operation and Maintenance (O&M) and decommissioning.</p>
Environmental Impact Assessment Regulations (EIA Regulations)	<p>Terminology used in this Offshore EIA Report to refer to three sets of regulations:</p> <ul style="list-style-type: none"> • The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017; • The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017; and • The Marine Works (Environmental Impact Assessment) Regulations 2007.
European Sites	<p>This term recognises SACs, candidate SACs (cSACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs), possible SACs (pSACs), potential SPAs (pSPAs) and Ramsar sites (where also designated as another European Site), which protect species and habitats shared across Europe and were originally designated under European legislation.</p>
Export Cable Corridor	<p>The area seaward of Mean High Water Springs (MHWS) which connects the Array Area with the Landfall within which the Offshore Export Cables will be installed.</p>
Habitats Regulations	<p>A term that refers to the collective legislation that translates the Habitats Directive into specific legal obligations in Scotland, namely: The Conservation (Natural Habitats, &c.) Regulations 1994; The Conservation of Habitats and Species Regulations 2017; and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (in each case as amended).</p>
Habitats Regulations Appraisal (HRA)	<p>An assessment carried out under the Habitats Regulations to determine if a plan or project could adversely affect the integrity of a European Site.</p>
Haul-Out Site	<p>Haul-out site is a location on land or ice where seals come ashore to rest, moult, or breed.</p>
Impact	<p>A change caused by an action that occurs during a project's lifetime.</p>
Impulsive Sound	<p>Sound which is broadband, very brief with a high rise time and high peak level compared to the energy averaged sound level.</p>
Inter-Array Cables (IAC)	<p>Cables which link the Wind Turbines to each other and with the Offshore Substation Platforms (OSPs).</p>

Defined Term	Definition
Inter-Related Effects	The potential effects of multiple impacts from the construction, O&M and decommissioning of the Project, affecting one receptor.
Interconnector Cables	Cables which will connect individual OSPs to each other to provide redundancy against cable failure elsewhere.
Intertidal Area	The area between MHWS and Mean Low Water Springs (MLWS).
Landfall	The area in which the Offshore Export Cables make landfall and is also the transitional area between the Offshore Transmission Assets and the Onshore Transmission Assets. Located in the Intertidal Area at Benholm.
Marine Directorate (MD)	The Marine Directorate of the Scottish Government, formerly known as Marine Scotland. The planning and licensing authority for Scotland's seas and custodian of Scotland's National Marine Plan (NMP). The Marine Directorate - Licensing Operations Team (MD-LOT) are specifically responsible for managing Section 36 Consent and Marine Licence Applications seaward of MHWS.
Marine Licence	A Marine Licence permits the undertaking of different activities in the marine environment, including construction, the deposition or removal of substances or objects, and dredging. The Marine (Scotland) Act 2010 requires Marine Licences to be obtained for licensable activities taking place within Scottish Territorial Seas (MHWS to 12 nm). The Marine and Coastal Access Act (MCAA) 2009 requires a Marine Licence to be obtained for licensable marine activities within the Scottish offshore region (12 nm – 200 nm).
Marine Protected Areas (MPAs)	MPAs are designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act (MCAA) 2009. The MPA network protects nationally and internationally important marine wildlife, habitats, geology, and underwater landforms. Scotland's MPAs are significantly important for European, North-East Atlantic, and global MPA networks.
Masking	The presence of one sound that makes it difficult to hear another.
Maximum Design Scenario (MDS)	The scenario within the design envelope likely to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor.
Mean High Water Springs (MHWS)	The average tidal height throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mitigation	Measures to avoid, prevent, reduce or control effects on the environment. See also definitions for Embedded Mitigation and Additional Mitigation.
Mysticete	An animal that belongs to a family of whales which use keratinaceous baleen plates in their mouths to sieve planktonic creatures from the water, a sub-group of the order Cetacea.
Non-Impulsive (or Continuous) Sound	Sound which is either continuous or intermittent but without the characteristics described above for impulsive sound.
Odontocete	An animal that belongs to the family of toothed whales, a sub-group of the order Cetacea.

Defined Term	Definition
Offshore Application	Term used to refer to the applications associated with the Proposed Development. The Applicant will apply for: <ul style="list-style-type: none"> • A Section 36 Consent under the Electricity Act 1989; and • Marine Licence(s) under Marine Scotland Act 2010 and Marine and Coastal Access Act 2009.
Offshore Environmental Impact Assessment (EIA) Report (hereafter, ‘Offshore EIA Report’)	Document prepared to report the findings of the EIA for the Proposed Development and produced in accordance with the EIA Regulations. The Offshore EIA Report is submitted to support the Offshore Application for the Proposed Development, and to comply with EIA Regulations.
Offshore Export Cables	Subsea cables used to transmit electricity generated offshore by the Wind Turbines from the OSPs to shore. The Transition Joint Bay (TJB) is the location where the Offshore Export Cables terminate, and the onshore cabling begins.
Offshore Generation Assets	The infrastructure of the Proposed Development required to generate electricity comprising of the Wind Turbines, Wind Turbine foundations and associated infrastructure e.g. IACs.
Offshore Infrastructure	All of the Offshore Infrastructure associated with the Proposed Development that is located seaward of MHWS, comprising the Offshore Generation Assets and the Offshore Transmission Assets.
Offshore Scoping Report	The report that presents the findings of the EIA scoping process undertaken for the Proposed Development with the purpose of obtaining a Scoping Opinion. The Offshore Scoping Report defines what is intended to be assessed and reported as part of the EIA.
Offshore Substation Platform(s) (OSP(s))	OSP(s) comprise the support structure, topside and electrical components used for collecting and/or converting electricity generated by the Wind Turbines for transmission by the Offshore Export Cables.
Offshore Transmission Assets	The infrastructure of the Proposed Development required to transmit the generated electricity comprising of the OSP(s), Offshore Export Cables and associated infrastructure up to MHWS.
Operation and Maintenance (O&M)	The phase of the Proposed Development following completion of construction. This phase of development includes routine inspections, repairs and replacement of infrastructure and equipment (including Interconnector Cables and IACs), Scour Protection replenishment or replacement, major component replacement, painting and/or other coating works, removal of marine growth, and replacement of access ladders.
Option to Lease Agreement (OLA)	An agreement between CES and a developer, permitting the future development of offshore wind within an agreed area.
Oslo Paris Convention (OSPAR)	Convention for the Protection of the Marine Environment of the North-East Atlantic.
Pathway	Describes the means or route by which a receptor (such as the seabed) can be affected by an identified impact source (such as Wind Turbine foundations).

Defined Term	Definition
Piling	The action of installing piles: installation can use various methodologies, the most common of which are impact piling (in which the piles are struck by a “hammer”) and drilling (during which a hole is drilled into the seafloor, the drilling tool is removed, and the pile is slotted into that hole).
Plan Option Area (POA)	A location identified in the Sectoral Marine Plan (SMP) as a preferred area for commercial scale offshore wind development.
Project (the)	An overarching term for the Bowdun Offshore Wind Farm (Bowdun OWF) comprising the offshore and onshore infrastructure required to generate and transmit electricity from the Array Area to the onshore Grid Connection Point (GCP). The Project includes the Offshore Generation Assets, the Offshore Transmission Assets and the Onshore Transmission Assets.
Project Design Envelope (PDE)	A description of the range of possible elements that make up the design options for the Proposed Development under consideration when the exact engineering parameters are not yet known.
Proposed Development	Term used to define the Offshore Infrastructure associated with the Project seaward of MHS for which consent is being sought. Further details of the parameters are included in Volume 1: Chapter 3: Project Description.
Qualifying Features	The features for which a European Site has been officially designated to protect.
Report to Inform Appropriate Assessment (RIAA)	The RIAA provides detailed information to support the process of AA (undertaken by the competent authority) as part of the HRA, which evaluates the potential impacts of a project or plan on European Sites.
Residual Effect	Remaining effects after applying all appropriate mitigation.
Scoping Opinion	A document produced by MD-LOT which is issued in response to submission and review of the Offshore Scoping Report. The Scoping Opinion is supported with feedback and advice from consultees, which details what is expected to be included in the Offshore EIA Report and what can be scoped out of the EIA process.
Scoping Workshop	A series of sessions preceding the finalisation of the Offshore Scoping Report to provide an opportunity for the Applicant to consult on the draft scope and for stakeholders to request additional information on key issues.
Scottish Marine Area	The area of sea within the seaward limits of the territorial sea of the United Kingdom adjacent to Scotland as defined by the Marine (Scotland) Act 2010.
Scottish Ministers (the)	The decision makers with regard to Marine Licence(s) and Section 36 Consent applications in Scottish Offshore Waters and Scottish Marine Area.
Scottish Offshore Waters	The area of sea beyond 12 nm but within the Scottish Exclusive Economic Zone (EEZ) up to 200 nautical miles from the coast.
Scour Protection	Protective materials installed to avoid sediment being eroded away from the base of the foundations and/or buried subsea cable due to the flow of water.

Defined Term	Definition
Section 36 Consent	Scottish Ministers' consent under Section 36 of the Electricity Act 1989 required to permit the generation and operation of an energy generation station .
Sectoral Marine Plan (SMP)	A plan developed by the Scottish Government which provide the strategically planned spatial footprint for offshore wind development in Scotland.
Sectoral Marine Plan Iterative Plan Review (SMP IPR)	The iterative plan review process as new information becomes available (e.g. consented projects, environmental data, cumulative effects assessment, etc.).
Significance	Effect factor that is determined by the magnitude of impact along with the sensitivity of the receptor.
Site Boundary	The boundary within which all elements of the Proposed Development will be located. The Site Boundary comprises the Array Area and Export Cable Corridor which ends at MHWS.
Special Areas of Conservation (SACs)	SACs are areas designated for the conservation of certain plant and animal species listed in the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
Study Area	For each environmental topic, the baseline environment will be characterised, and the potential environmental impacts will be described within a topic-specific study area. Specific study areas are defined for each topic and are based on the maximum spatial extent across which potential impacts of the Project may be experienced by the relevant receptors (i.e. Zone of Influence).
Thistle Wind Partners (TWP)	Company established for the development of the Project.
Transition Joint Bay (TJB)	Used to connect the Offshore Export Cables with the onshore export cables. These are typically concrete lined and are located above MHWS.
Wind Turbines	Structures comprising of a tubular tower, rotor blades, and a nacelle which houses the Wind Turbine generator.

Acronyms

Acronym	Definition
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AIS	Automatic Identification System
AUD INJ	Auditory injury
AUV	Autonomous Underwater Vehicle
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy and Industrial Strategy
BOWFL	Bowdun Offshore Wind Farm Limited
CEA	Cumulative Effects Assessment
CGNS	Celtic and Greater North Seas
CI	Confidence Interval
CIEEM	Chartered Institute for Ecology and Environmental Management
CMS	Construction Method Statement
CNSE	Central North Sea Electrification
CoCP	Code of Construction Practice
CPT	Cone Penetration Test
CSIP	Cetacean Strandings Investigation Programme
CTV	Crew Transfer Vessels
DAS	Digital Aerial Surveys
DEFRA	Department for Environment Food and Rural Affairs
DP	Dynamic Positioning
DSV	Dive Support Vessel
EC	European Commission
EcIA	Ecological Impact Assessment
eDNA	Environmental Deoxyribonucleic Acid
EDR	Effective Deterrence Range
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
FCS	Favourable Conservation Status
FHG	Functional Hearing Groups
GIS	Geographic Information System
GNS	Greater North Sea
HDD	Horizontal Directional Drilling

Acronym	Definition
HF	High Frequency
HRA	Habitats Regulations Appraisal
HSE	Health and Safety Executive
HVDC	High Voltage Direct Current
IAC	Inter-Array Cable
IAMMWG	Inter-Agency Marine Mammal Working Group
IEF	Important Ecological Feature
INNS	Invasive Non-Native Species
INNSMP	Invasive Non-Native Species Management Plan
iPCoD	Interim Population Consequences of Disturbance Model
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
LSE	Likely Significant Effects
MBES	Multibeam Echosounder
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act 2009
MDS	Maximum Design Scenario
MD-LOT	Marine Directorate - Licensing Operations Team
MHWS	Mean High Water Spring
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MU	Management Unit
ncMPA	Nature Conservation Marine Protected Area
NEQ	Net Explosive Quantity
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Physical Laboratory
NRA	Navigational Risk Assessment
NSVMP	Navigation Safety and Vessel Management Plan
ORJIP	Offshore Renewables Joint Industry Programme
OSP	Offshore Substation Platform
OSPAR	Oslo Paris Convention
OWF	Offshore Wind Farm
O&M	Operation and Maintenance
PCW	'Phocid carnivores in water'

Acronym	Definition
PDE	Project Design Envelope
PEMP	Project Environmental Monitoring Programme
PLGR	Pre-lay Grapnel Run
PMF	Priority Marine Feature
POA	Plan Option Area
PTS	Permanent Threshold Shift
PW	Phocid Pinnipeds
RIAA	Report to Inform Appropriate Assessment
rms	Root Mean Square
SAC	Special Area of Conservation
SBP	Sub-bottom Profiler
SCANS	Small Cetaceans in European Atlantic Waters and the North Sea
SCOS	Special Committee on Seals
SEL	Sound Exposure Level
SMU	Seal Monitoring Unit
SMP	Sectoral Marine Plan
SMRU	Sea Mammal Research Unit
SMWWC	Scottish Marine Wildlife Watching Code
SNCBs	Statutory Nature Conservation Bodies
SOV	Service Operation Vessel
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
SSS	Side Scan Sonar
TTS	Temporary Threshold Shift
TWP	Thistle Wind Partners Limited
UK	United Kingdom
UHRS	Ultra High-Resolution Seismic
USV	Unmanned Surface Vehicle
UXO	Unexploded Ordnance
VHF	Very High Frequency
ZoI	Zone of Influence

Table of Units

Units	Definition
%	Percent
dB	Decibel
GW	GigaWatt
kg	Kilogram
kHz	Kilohertz
kJ	Kilojoule
km	Kilometre
km²	Square kilometre
kts	knots
kV	Kilovolt
m	Metre
m/s	Metre per second
m²	Square Metre
MW	MegaWatt
nm	Nautical mile
rms	Root mean square
s	seconds
SEL_{cum}	Cumulative Sound Exposure Level
SEL_{ss}	Single strike Sound Exposure Level
SPL_{pk}	Peak Sound Pressure Level
μPa	Micro Pascal (10 ⁻⁶)

10 Marine Mammals

10.1 Introduction

10.1.1 This chapter of the Offshore Environmental Impact Assessment (EIA) Report presents the assessment of the likely significant environmental effects on marine mammals, that may occur as a result of the Proposed Development during the construction (including pre-construction activities), Operation and Maintenance (O&M) and decommissioning phases.

10.1.2 The marine mammal assessment is informed by the following:

- Chapters:
 - Volume 2, Chapter 7: Physical Processes;
 - Volume 2, Chapter 8: Benthic Ecology;
 - Volume 2, Chapter 9: Fish and Shellfish Ecology;
 - Volume 2, Chapter 14: Shipping and Navigation;
- Appendices:
 - Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report;
 - Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report;
 - Volume 3, Technical Appendix 10.3: Marine Mammal Interim Population Consequences of Disturbance Model (iPCoD) Modelling Report;
 - Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report;
 - Volume 3, Technical Appendix 8.3: Marine Protected Area Assessment; and
 - Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol (MMMP).

10.2 Marine Mammals Study Area

10.2.1 Marine mammals are highly mobile and wide-ranging species, with varied behaviour and ecology between species. To account for this and to provide a wider geographic context, the Marine Mammal Study Area has been defined at two spatial scales (Figure 10.1):

- The Local Marine Mammal Study Area is defined as the Site Boundary plus a 12 km buffer. A site-specific Digital Aerial Survey (DAS) campaign was conducted over a 24-month period (March 2022 to February 2024), which covered the original E3 Plan Option Area (POA) plus a 12 km buffer (the buffer has been extended to surround the Site Boundary); between April and August the coverage of DAS flights extended west to the Aberdeenshire coast (defined in Section 4.3, Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report as the 'Extended DAS Area'); and

- The Regional Marine Mammal Study Area is defined as the area encompassing the Site Boundary and extending further into the northern North Sea towards Scandinavia. This was informed by species-specific Management Units (MU) for cetaceans as defined by the Inter-Agency Marine Mammal Working Group (IAMMWG) and the Seal Monitoring Units (SMU) as defined by the Special Committee on Seals (SCOS) (IAMMWG, 2023; SCOS, 2023). The MU boundaries are intended to inform the spatial scale for marine mammal population impact assessment. Further details and geographical extent of the species-specific relevant MUs is provided in Section 10.6. Due to the highly mobile nature of marine mammals, the Regional Marine Mammal Study Area is used to provide a wider geographic context compared to the Local Marine Mammal Study Area. Relevant MUs considered were the North Sea MU for harbour porpoise *Phocoena phocoena*, the Coastal East Scotland MU and Greater North Sea (GNS) MU for bottlenose dolphin *Tursiops truncatus* and the Celtic and Greater North Seas (CGNS) MU for minke whale *Balaenoptera acutorostrata*, Risso's dolphin *Grampus griseus* and white-beaked dolphin *Lagenorhynchus albirostris*, together with the East Scotland SMU for both grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina* and Moray Firth SMU and North Coast and Orkney SMU for grey seal only. The Regional Marine Mammal Study Area is informed by the North Sea MU for harbour porpoise and the CGNS MU for bottlenose dolphin, and is extended across the North Sea, broadly to encompass the relevant Small Cetaceans in European Atlantic waters and the North Sea (SCANS) survey blocks (see Figure 4.2 and Figure 4.3, Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). This provides an area which is representative of the potential species connectivity with the Proposed Development.

- 10.2.2 In addition, Risso's dolphin, humpback whale *Megaptera noveangliae* and fin whale *Balaenoptera physalus* are assessed qualitatively within this impact assessment, due to a lack of relevant density estimates for these species. The qualitative assessment for these species includes a review of relevant literature in order to best assess the potential impacts from the Proposed Development.
- 10.2.3 The Marine Mammal Study Areas at both spatial scales were detailed in the Scoping Report to the Marine Directorate – Licensing and Operations Team (MD-LOT), and the Scoping Opinion confirmed agreement that these areas broadly captured the likely Zones of Influence (Zois) for marine mammals (MD-LOT, 2024a).

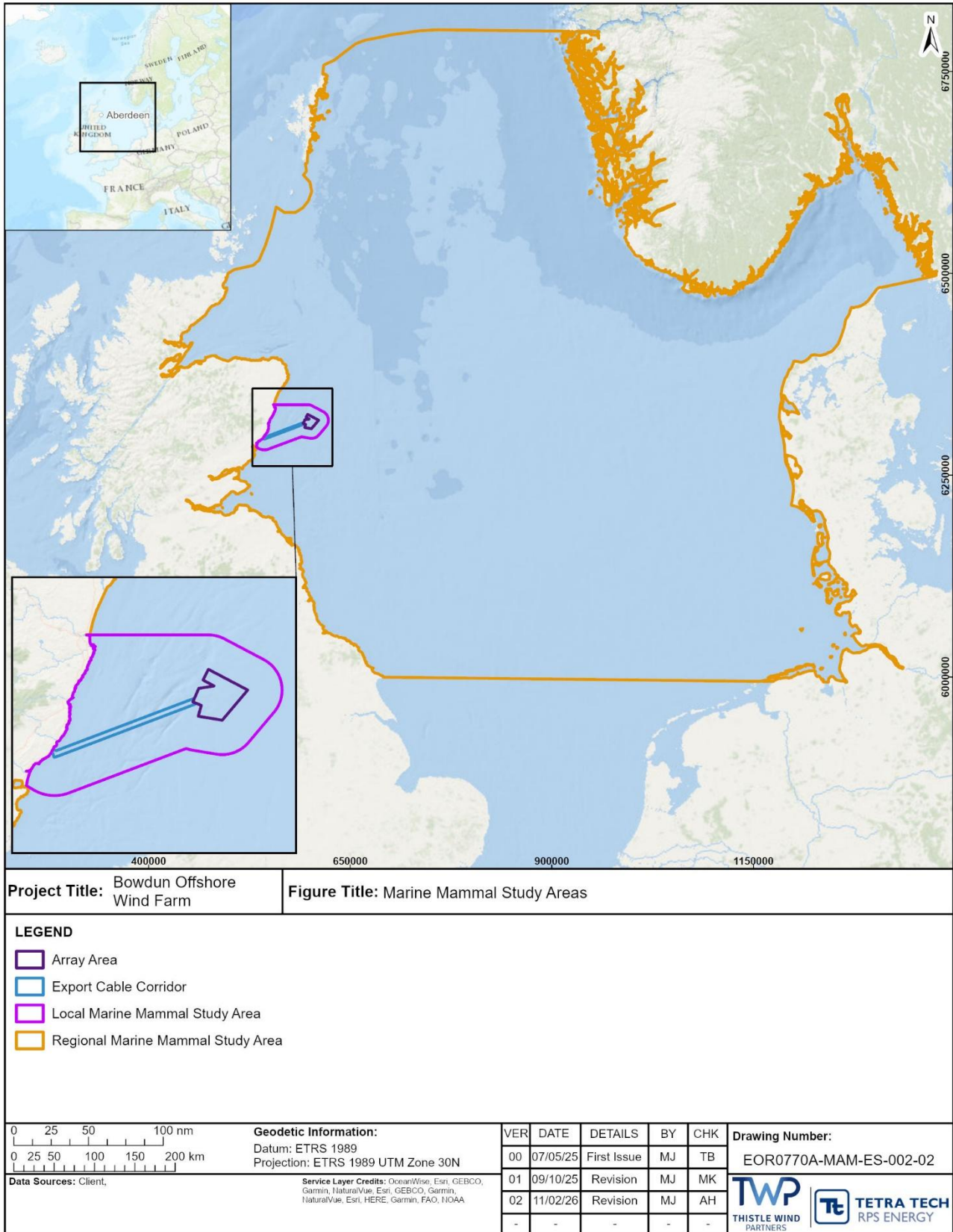


Figure 10.1: Marine Mammal Study Areas

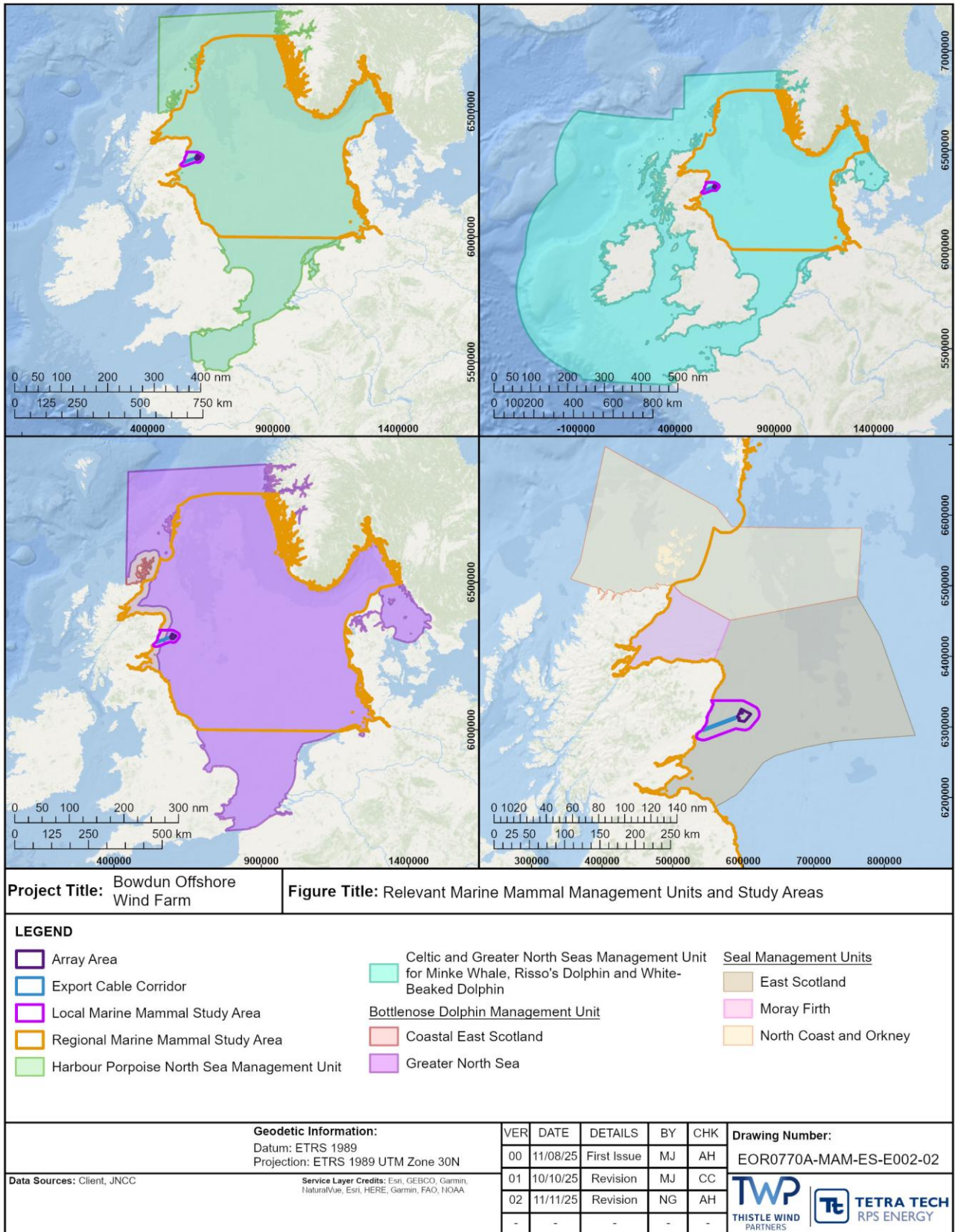


Figure 10.2: Relevant Marine Mammal MUs and Study Areas

10.3 Legislative and Policy Context

10.3.1 The overarching policy and legislation applicable to the Proposed Development is presented in Volume 1, Chapter 2: Policy and Legislation. A summary of the legislative provisions and policies relevant to marine mammals are provided in Table 10.1 to Table 10.11 below.

Table 10.1: Summary of Marine (Scotland) Act 2010 Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
Habitat Health	
The Scottish Ministers and public authorities must act in the way best calculated to further the achievement of sustainable development, including the protection and, where appropriate, enhancement of the health of that area.	The assessment of the environmental impacts of the Proposed Development on the marine mammals is presented in Section 10.10.
Protection of Seals	
The Act provides provisions relating to protection for seals. Certain haul-out sites have been designated under The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 (as amended). At these sites, it is an offence to intentionally or recklessly harass a seal.	The designated haul-out sites located in vicinity to the Array Area are described in Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report.
The Act seeks to balance seal conservation with other pressures and requirements (such as species conservation). Part 6 prohibits the intentional or reckless killing, injuring or taking of seals except under specific licence.	No licence is required as there will be no killing, injuring or taking of seals in any phase of the Proposed Development. The assessment of the environmental impacts of the Proposed Development on the marine mammals is presented in Section 10.10.
Nature Conservation Marine Protected Areas	
The Marine (Scotland) Act 2010 provides for the development of a marine spatial planning system, creating a framework for marine developments and enables the creation of Nature Conservation Marine Protected Areas (ncMPA)	The Southern Trench ncMPA, designated for minke whale, is in Scottish inshore waters (within 12 nm) and is listed in Section 10.6 and potential effects on this are considered in Section 10.10.

Table 10.2: Summary of Habitats Regulations Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
European Sites	
Before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which is likely to have a significant effect on a European offshore marine site or a European site (either alone or in combination with other plans or projects) and is not directly connected with or necessary to the management of the site, a competent authority must make an Appropriate	All European Sites for Annex II Species which are marine mammals, relevant to the Proposed Development are listed in Section 10.5 and effects on these are considered in Section 10.10. European sites are further assessed in accordance with the Habitats Regulations Appraisal (HRA) is presented in the HRA, Report to

Summary of relevant legislation	How and where considered in the Offshore EIA Report
<p>Assessment of the implications of the plan or project for that site in view of that site's conservation objectives. If the competent authority is satisfied that, there being no alternative solutions, the plan or project must be carried out for imperative reasons of over-riding public interest it may agree to the plan or project notwithstanding a negative assessment of the implications for the European Site and if compensatory measures can be secured.</p>	<p>Inform Appropriate Assessment, Part 2: Special Areas of Conservation (TWP-BOW-RPS-OFE-RPT-00014).</p>
<p>Species Protection</p>	
<p>A person is guilty of an offence if they deliberately or recklessly capture, injure, kill or disturb any wild animal of a European Protected Species (EPS) in Scottish inshore waters (within 12 nm of the coast), or deliberately capture, injure, kill or disturb any wild animal of an EPS in offshore waters from 12 to 200 nm. All cetacean species are EPS, being listed in Annex IV(a) of the Habitats Directive. The grey seal and common seal are not EPS.</p>	<p>All the relevant protected species have been identified in Section 10.6. The environmental assessments of impacts of the Proposed Development on marine mammals provided in Section 10.10 consider the conservation status of marine mammals when determining the significance of effect and proposed mitigation. An EPS licence will be applied for in relation to any activity which has potential to result in an offence and this application would be informed by the assessments presented in Section 10.10.</p>

Table 10.3: Summary of the Nature Conservation (Scotland) Act 2004 Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
<p>General Principles</p>	
<p>Places duties on public bodies in relation to the conservation of biodiversity and strengthens wildlife enforcement legislation. The Act amends the Wildlife and Countryside Act 1981 to extend wild animal protection to include reckless as well as intentional acts (Schedule 6, paragraph 8(6)).</p>	<p>Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.</p>

Table 10.4: Summary of Scotland's National Marine Plan (2015) Relevant to Marine Mammals

Summary of relevant policy	How and where considered in the Offshore EIA Report
<p>General Policies</p>	
<p>GEN 9 section of the Plan refers to Natural Heritage and provides that "<i>Development and use of the marine environment must:</i></p> <ul style="list-style-type: none"> • <i>comply with legal requirements for protected areas and protected species;</i> • <i>not result in significant impacts on the national status of Priority Marine Features (PMF); and</i> 	<p>Marine mammal protected species and PMFs are identified in Section 10.6. Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammals along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.</p>

Summary of relevant policy	How and where considered in the Offshore EIA Report
<ul style="list-style-type: none"> • <i>protect and, where appropriate, enhance the health of the marine area.</i>” (GEN 9 Natural Heritage) 	
<p>Paragraph 4.47 <i>et seq.</i> of the Plan refers to ncMPAs. It provides that <i>“The Marine Acts place a duty on all regulators to ensure that there is no significant risk of hindering the achievement of the conservation objectives of a ncMPA before giving consent to an activity. Where an ongoing activity presents a significant risk of hindering the achievement of the conservation objectives of an MPA there will be a management intervention. This intervention will be practical and proportionate, utilising the most appropriate statutory mechanism to reduce the risk.”</i> (Site protection, Paragraph 4.47 to 4.48)</p>	<p>Section 10.10 presents assessments of the significance of the effects as a result of the construction, O&M and decommissioning phases of the Proposed Development on marine mammal receptors with respect to the designated sites, including the Southern Trench ncMPA.</p>
<p>Paragraph 4.51 <i>et seq.</i> of the Plan refers to protected species and provides that <i>“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. (...) For certain species deliberate or reckless disturbance or harassment is prohibited and can only be carried out in accordance with the terms of a licence.”</i> (Site protection, Paragraph 4.51 - 4.53)</p>	<p>Marine mammal protected species and PMFs are identified in Section 10.6. Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammals along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts. An EPS licence will be applied for in relation to any activity which has potential to result in an offence and this application would be informed by assessment presented in Section 10.10.</p>
<p>GEN 5 Climate Change: Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change. (GEN 5 Climate Change)</p>	<p>The impact of climate change on the baseline environment and how this may influence the assessment of effects is considered as part of the future baseline in Section 10.6. A climate change assessment has been undertaken that considers the Proposed Development in the context of climate change in Volume 2, Chapter 22: Climate Change.</p>
<p>GEN 13 Noise: Developments should avoid significant adverse effects of man-made noise and vibration on marine ecosystems and users. Where avoidance is not possible, mitigation must be applied. (GEN 13 Noise)</p>	<p>Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.</p>
<p>GEN 21 Cumulative Impacts: Cumulative impacts of multiple activities must be considered, including past, present, and foreseeable future developments. (GEN 21 Cumulative Impacts)</p>	<p>A Cumulative Effects Assessment (CEA) is presented in Section 10.12, evaluating the combined impact of the Proposed Development with other projects on marine mammals, in the Regional Marine Mammal Study Area.</p>

Table 10.5: Summary of PMF in Scotland’s Seas - Habitats Relevant to Marine Mammals (NatureScot, 2020)

Summary of relevant policy	How and where considered in the Offshore EIA Report
Marine Mammal Species	
PMFs are habitats and species that have been identified as being conservation priorities in Scottish waters. These include 16 species of marine mammals.	Marine mammal PMFs are identified in Section 10.6. Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.

Table 10.6: Summary of The Sectoral Marine Plan for Offshore Wind Energy 2020¹ Relevant to Marine Mammals

Summary of relevant policy	How and where considered in the Offshore EIA Report
General Policies	
Minimise the potential adverse effects on other marine users, economic sectors and the environment resulting from further commercial scale offshore wind development. (Marine Spatial Planning, Section 2.1)	Section 10.10 presents assessments of the significance of the effects as a result of the construction, O&M and decommissioning phases of the Proposed Development on marine mammal receptors.
Offshore Wind and Marine Renewable Energy Policies	
Regional cumulative effects include the potential for negative effects on bird populations, benthic habitats, cetaceans, navigational safety, seascape/landscape and commercial fisheries. The Sectoral Marine Plan (SMP) includes measures to mitigate potential impacts at various scales. (Environmental Effects, Section 4.1)	Section 10.12 considers impacts from the Proposed Development cumulatively with other projects. The consideration of impacts on the relevant European sites from the Proposed Development cumulatively with other projects is provided in the Report to Inform Appropriate Assessment (RIAA) Part 2: Special Areas of Conservation (TWP-BOW-RPS-ENV-OFE-00014), alongside relevant mitigation measures.

¹ At the time of writing, the SMP is subject to an iterative review process, therefore, the information provided within this chapter is based upon the SMP published by the Scottish Government in 2020.

Table 10.7: Summary of The United Kingdom (UK) Marine Policy Statement Relevant to Marine Mammals

Summary of relevant policy	How and where considered in the Offshore EIA Report
General Policies	
<p>Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets. (Introduction)</p>	<p>The magnitude of impacts and the sensitivity of marine mammal receptors are assessed in Section 10.10 to determine if the impacts as a result of the construction, O&M and decommissioning phases of the Proposed Development may result in a significant effect on the marine mammal receptors.</p>
<p>The marine environment plays an important role in mitigating climate change. (Achieving the Vision Through Marine Planning, Section 2.2)</p>	<p>The impact of climate change on the baseline environment and how this may influence the assessment of effects is considered as part of the future baseline in Section 10.6. A climate change assessment has been undertaken that considers the Proposed Development in the context of climate change in Volume 2, Chapter 22: Climate Change.</p>
<p>Biodiversity is protected, conserved and where appropriate recovered and loss has been halted. (Achieving the Vision Through Marine Planning, Section 2.2)</p>	<p>Marine mammal PMFs are identified in 10.6. Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.</p>
Offshore Wind and Marine Renewable Energy Policies	
<p>Marine businesses are acting in a way which respects environmental limits and is socially responsible. (Achieving the Vision Through Marine Planning, Section 2.2)</p>	<p>As part of the Proposed Development design process, a number of Embedded Mitigation measures have been proposed to reduce the potential for impacts on marine mammals (see Table 10.30; Section 10.9). They are considered at every stage of the Proposed Development through design and best practice and, as there is a commitment to implementing these measures.</p>

Table 10.8: Summary of The Scottish Biodiversity Strategy (Scottish Government, 2023) Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
General Principles	
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.	Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors, along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.

Table 10.9: Summary of the Marine Strategy Framework Directive (Directive 2008/56/EC) 2008, Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the EIA Report
General Principles	
The Marine Strategy Framework Directive (2008/56/EC) establishes a framework for protecting the marine environment across European Union (EU) waters, aiming to achieve Good Environmental Status. It is particularly important for marine mammals, as it requires Member States to monitor and manage pressures such as underwater noise, contaminants, and habitat degradation factors known to affect cetaceans and pinnipeds. The Directive’s biodiversity and noise descriptors directly support the conservation of marine mammals by promoting coordinated action to reduce disturbance, improve habitat quality, and ensure long-term population viability.	Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors, along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.

Table 10.10: Summary of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) 1992, Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
General Principles	
The OSPAR Convention (1992) provides a framework for international cooperation to protect the marine environment of the North-East Atlantic. It is particularly important for marine mammals, as it includes provisions to reduce pollution, manage human activities, and conserve biodiversity through Annex V. The Convention supports the designation of Marine Protected Areas (MPAs), promotes ecosystem-based management, and addresses threats such as underwater noise, contaminants, and habitat degradation factors known to impact cetaceans and pinnipeds.	Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors, along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.

Table 10.11: Summary of the Protection of Seals (Designation of Seal haul-Out Sites) (Scotland) Order 2014, Relevant to Marine Mammals

Summary of relevant legislation	How and where considered in the Offshore EIA Report
General Principles	
<p>The Order makes it an offence to intentionally or recklessly harass seals at any of the designated seal haul-out sites around Scotland.</p>	<p>Section 10.10 presents an assessment of the significance of the effects of the Proposed Development on marine mammal receptors, along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts.</p> <p>Potential seal haul-out sites were identified in Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report; however, there are no designated seal haul-out sites near or within the proposed cable landfall area, therefore there is no potential for a harassment offence to occur.</p>

10.4 Consultation

10.4.1 The approach to consultation for the Proposed Development is set out in Volume 1, Chapter 5: Consultation and Engagement. A summary of the issues raised during consultation activities undertaken to date specific to marine mammals is presented in Table 10.12, together with how these issues have been considered in the production of this assessment. Further detail is presented within Volume 1, Chapter 5: Consultation and Engagement, Volume 3, Technical Appendix 5.1: Consultation Log and Volume 3, Technical Appendix 5.2: Pre-Application Consultation Report.

Table 10.12: Summary of Key Consultation Issues Raised During Consultation Activities Undertaken for the Proposed Development Relevant to Marine Mammals

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Scoping Opinion			
11/10/2024	NatureScot (2024 Bowdun Offshore Wind Farm (OWF) Scoping Opinion – Scoping Response)	There is a need to understand potential impacts holistically at a wider ecosystem scale in addition to the standard set of discrete individual receptor assessments. This assessment should focus on potential impacts across predator prey interactions. This will enable a better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance from the Proposed Development on bird and mammal (and other top predator) interests and what influence this may have on population-level impacts.	The Applicant confirmed that an assessment of the likely consequences (beneficial or adverse) of any potential changes in prey distribution and abundance from the Proposed Development on relevant marine mammals has been undertaken (including and potential influence this may have on population-level impacts). The marine mammal EIA chapter has drawn on the assessment of Fish and Shellfish Ecology (Volume 2, Chapter 9: Fish and Shellfish Ecology) and presented an assessment under the impact assessment Changes to prey availability (see Section 10.10).
		The Marine Mammal Study Areas are defined in Section 11.2 and Figure 11.1. We are content with the approach to use a local scale study area based on the DAS (12 km DAS buffer) and a regional scale study area covering a wider area of the North Sea as defined by relevant IAMMWG Mus.	The Applicant noted this response.

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>As good practise measures, we recommend the Scottish Marine Wildlife Watching Code (SMWWC) is used to minimise disturbance to marine mammals and, if possible, use of night vision binoculars for pre geophysical survey/piling/Unexploded Ordnance (UXO) clearance, particularly in poor visibility or at night.</p>	<p>The Applicant noted this advice and confirms adherence to the SMWWC to minimise disturbance to marine mammals from piling and construction activities has been included in the Embedded Mitigation measures relevant to marine mammals (see Table 10.30).</p> <p>Regarding the use of night vision binoculars, the use of infrared (IR) night time vision technology for mitigation purposes remains in its early stages. Ocean Science Consulting (OSC, 2025) has conducted preliminary research and field trials of night vision systems during marine mammal observations, which yielded unsatisfactory results. Further, thermal IR cannot detect animals subsurface. However, the potential for the future use of night time vision binoculars has been included within the Outline MMMP for consideration within the Finalised MMMP Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol (MMMP)).</p>
		<p>Proposed monitoring has not been detailed for marine mammals within the Scoping Report. For the monitoring of potential impacts to marine mammals we encourage consideration of a strategic approach with adjacent Offshore Wind Farms, especially with the use of novel floating technology and the lack of information we currently have on operational noise. We would welcome an outline of potential monitoring plans for the Offshore EIA Report and as we believe it is important to take industry opportunities to learn more about the baseline of marine mammals in Scotland, we would promote further consultation on monitoring approaches.</p>	<p>The Applicant noted the advice on approach to monitoring and will look to identify opportunities for strategic monitoring in collaboration with other offshore wind farms if considered relevant. The Applicant confirms that any outline monitoring plans developed for the Bowdun Project will be provided for discussion with NatureScot and MD-LOT.</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
25/11/2024	MD–LOT (2024 Bowdun Offshore Wind Farm Scoping Opinion)	<p>Section 3.10 and Table 3.13 of the Scoping Report provide generalised detail of the construction phases planned until 2029 if a s.36 consent and marine licences are granted, including pre-construction surveys and activities. The Offshore EIA Report must describe and assess the environmental effects of the range of surveys which may be required, including in combination effects. The Offshore EIA Report must also include consideration of the options which will be assessed in relation to potential clearance of UXO, discussed in section 3.7.1 of the Scoping Report, the differences amongst them and an assessment of the environmental effects of these options, including in combination effects with other projects. In this regard the Scottish Ministers advise that the Offshore EIA Report must include a maximum design of high order detonation in terms of impact and mitigation, unless there is robust supporting evidence that can be presented to show the consistent performance of the preferred low order or deflagration method.</p>	<p>This marine mammal EIA chapter has included an assessment of the potential impact of noise resulting from site-investigation surveys as well as UXO clearance, considering high order detonation as the Maximum Design Scenario (MDS) for the project alone and for in combination with other projects (see Section 10.10 and Section 10.12)</p>
		<p>In Table 8.2 of the Scoping Report the Developer summarises the subsea noise impacts to be scoped in for further assessment within the Offshore EIA Report. The Scottish Ministers note that injury ranges for marine mammals and fish will be estimated for clearance of UXO. The Scottish Ministers advise that disturbance is also assessed using Temporary Threshold Shift as a proxy. This is supported by the NatureScot EIA response.</p>	<p>The Applicant confirms that the use of the Temporary Threshold Shift (TTS) criteria, has been applied as a proxy for disturbance for UXO clearance assessment only (see Section 10.10, Paragraph 10.10.143).</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers agree with the Developer’s intention to scope in potential impacts of UXO clearance in terms of subsea noise during the construction phase of the Proposed Development. However, the Scottish Ministers also note the representation from the Ministry of Defence which states that the potential presence of UXOs and disposal sites should also be considered for the decommissioning phase and where any other intrusive works may take place. The Scottish Ministers therefore advise that the potential impacts of UXO clearance be scoped in for all stages of the Proposed Works.</p>	<p>The Applicant confirms that the impact of injury and disturbance from subsea noise generated during UXO clearance has been scoped in only for the construction phase (as set out in Table 11.9 of the Bowdun Scoping Report). This is considered appropriate on the basis that all UXO posing a risk to construction activities would also be relevant to the decommissioning phase and therefore will have been cleared during the construction phase. The Applicant therefore believes that it would not be appropriate to present an assessment for the decommissioning phase additionally.</p>
		<p>Table C1.3 within Appendix C of the Scoping Report provides a summary of the approach to the modelling of disturbance to marine mammals from all sources. The Scottish Ministers agree that the dose-response approach should be used for piling, however, note that Graham <i>et al.</i> (2017) should be used for cetaceans. Additionally, in line with the NatureScot EIA response, for impulsive noise sources, the Scottish Ministers advise presenting thresholds as peak, instead of rms, to allow comparison with the Southall thresholds.</p>	<p>The Applicant confirms that the reference provided for cetaceans for the dose-response approach should have been Graham <i>et al.</i>, 2017, not Graham <i>et al.</i>, 2019. The Applicant therefore confirms that the Graham <i>et al.</i>, 2017 reference was used to inform the dose-response approach (see Paragraph 10.8.29). The Applicant confirms that Southall (2019) SPL_{pk} thresholds is included within the Subsea noise Technical report (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report) for comparison but for the assessment of injury for impulsive noise sources the recently updated guidance published by the National Marine Fisheries Service (NMFS, 2024) has been used (see Section 10.8 of Volume 2 Chapter 10: Marine Mammals).</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers, in line with the NatureScot EIA response, advise that the Offshore EIA Report should clearly set out the impacts to key prey species and their habitats arising from the Proposed Development alone and cumulatively with other wind farms. The Scottish Ministers acknowledge the need to understand impacts at the ecosystem scale; therefore, advise that consideration across key trophic levels will enable a better understanding of the consequences of any potential changes in prey distribution and abundance on marine mammal interests and how this may influence population-level impacts. Additionally, the Scottish Ministers advise that consideration of how this loss and/or disturbance may affect the recruitment of key prey (fish) species through impacts to important spawning or nursery ground habitats should also be assessed within the Offshore EIA Report. The Predators and Prey Around Renewable Energy Developments project⁴ may be helpful when carrying out this assessment. This is also supported by the NatureScot EIA response.</p> <p>⁴ PrePARED – An offshore renewables science project (owecprepared.org)</p>	<p>The Applicant confirms that the marine mammal EIA chapter has drawn on the assessment of Fish and Shellfish Ecology (Volume 2, Chapter 9: Fish and Shellfish Ecology) to assess the likely consequences (positive or negative) of any potential changes in prey distribution and abundance from the Proposed Development on relevant marine mammals, presented under the impact assessment changes to prey availability (see Section 10.10).</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>With regards to baseline characterisation, the Scottish Ministers are broadly content with the proposed data sources identified in Table 11.1 of the Scoping Report, however, refer the Developer to the NatureScot representation regarding further recommended data sources. The highest density estimate for each species should be used from DAS and SCANS, the advice from NatureScot in this regard must be fully addressed in the Offshore EIA Report. The Scottish Ministers draw attention to the advice provided by NatureScot on the aforementioned date about the absence of seal population estimates in SCOS 2023. The Scottish Ministers recommends the Developer reviews and incorporates the most recent SCOS report when undertaking the marine mammal assessment within the Offshore EIA Report.</p>	<p>The Applicant noted this response. The data sources as recommended by NatureScot have been used to inform the assessment where relevant (see Section 10.5). All relevant density estimates have been presented in the Marine Mammal Technical Report (Volume 5, Appendix 10.1: Marine Mammal Technical Report), and the most robust precautionary density estimate has been taken through to the assessment in the Marine Mammal EIA Chapter (see Table 10.15). The Applicant confirms that seal population estimates from the most recent SCOS report have also been incorporated (see Table 10.15).</p>
		<p>The Scottish Ministers are broadly content with the study areas described in Section 11.2.1 of the Scoping Report. The Scottish Ministers, in line with the NatureScot representation, note that the UK portion of the Management Unit should be used in the Offshore EIA Report.</p>	<p>The assessment of effects on marine mammal receptors is carried out with respect to the study areas and UK portion of the MU are presented in Section 10.2.</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>With regards to baseline characterisation, the Scottish Ministers are broadly content with the proposed data sources identified in Table 11.1 of the Scoping Report, however, refer the developer to the NatureScot representation regarding further recommended data sources omitted from the Scoping Report.</p> <p>The highest density estimates for each species should be used from DAS and SCANS, the advice from NatureScot in this regard must be fully addressed in the EIA Report.</p> <p>The Scottish Ministers draw attention to the advice provided by NatureScot on the absence of seal population estimates in SCOS 2023. The Scottish Ministers recommends the Developer to review and incorporate the most recent SCOS report when undertaking the marine mammal assessment within the Offshore EIA Report.</p> <p>The Scottish Ministers advise that alongside the species the Developer has scoped in for assessment, Risso’s Dolphin should be included qualitatively. This is supported by the NatureScot EIA response.</p>	<p>Acknowledged. Further data sources as recommended by NatureScot have been reviewed and included where appropriate (see Section 10.5).</p> <p>The highest appropriate density estimates have been used (Section 10.10).</p> <p>The reference to SCOS 2023, refers to the SCOS report for 2022 see Section 10.15. The most recent SCOS information available at the time of writing has been used for the marine mammal assessment.</p> <p>Risso’s dolphin are included in the assessment of effects in Section 10.10 following advice from MD-LOT and NatureScot.</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers are generally content with the impacts scoped in as per Table 11.9 of the Scoping Report. However, the Scottish Ministers advise that indirect impacts from Electromagnetic Field (EMF) should be scoped in for further assessment within the Offshore EIA Report, cross-referencing between the fish and shellfish and marine mammal chapters. This is supported by NatureScot EIA response.</p>	<p>The Applicant concluded after further consideration with experts that the direct impacts from EMF have been scoped out as well as the impacts from entanglement. The Proposed Development will develop fixed Wind Turbine foundations only. A full explanation for this is presented in Table 10.20 of Section 10.7. The Applicant confirms that the indirect impacts from EMF are considered within the assessment for effects on marine mammals due to altered prey availability (see Table 10.19 and Section 10.10) which refers to the assessment from the Fish and Shellfish Ecology chapter (Volume 2, Chapter 9: Fish and Shellfish Ecology).</p>
		<p>The Scottish Ministers also note that Table 11.9 in the Scoping Report discusses injury and disturbance from subsea noise to marine mammals. Per the NatureScot EIA response, the Scottish Ministers advise that the Developer clarifies the term “<i>residual effect</i>” used in Table 11.9 within the Offshore EIA Report.</p> <p>Furthermore, the Developer should present the percentage of the reference population affected in the Offshore EIA Report and, unless sound levels are predicted to exceed Permanent Threshold Shift (PTS) from operational or other construction activities, then PTS does not need to be included in the Offshore EIA Report other than when considering impulsive noises.</p>	<p>The Applicant confirms that the meaning and application of 'residual effect' has been set out in this marine mammal EIA chapter (please see the Glossary) and is presented in Section 10.10 for the assessment impacts.</p> <p>The Applicant also confirms that percentages of reference populations with the potential to be affected will be presented in Section 10.6, Table 10.15 (where quantification is possible).</p> <p>Furthermore, the Applicant notes the advice regarding the need to include PTS, which will be applied in line with underwater noise modelling report and is presented in Section 10.10.</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers do not support the Developer’s decision, set out in Section 11.7.2 of the Scoping Report, to group marine mammal species into broad ecological groups. The Scottish Ministers expect marine mammal species to be assessed independently in the Offshore EIA Report. For species where a quantitative assessment is possible, the Scottish Ministers expect to see a percentage of each species respective (UK portion) reference population when assigning the magnitude of each assessed impact. This is supported by the NatureScot EIA response.</p>	<p>The Applicant agrees that the wording set out in 11.7.2 of the Bowdun Scoping Report could lead the reader to believe that marine mammals will be assessed by Important Ecological Features (IEF) groupings. However, the Applicant confirms that all marine mammal species have been assessed independently (quantitatively, or for some species qualitatively) (see Section 10.10). The assessment of significance has occasionally grouped species taxonomically (e.g. dolphin species) when providing ecological baseline information (e.g. see Paragraph 10.10.101), but final conclusions of magnitude of impact, sensitivity of receptor and significance of effect will be applied for each species independently (see Section 10.10).</p> <p>Additionally, for the underwater noise modelling methodology, marine mammals have been grouped into Functional Hearing Groups (FHG) for assessment against the appropriate threshold criteria (e.g. NMFS, 2024) (see Table 10.25 and Table 10.27). The results of the noise modelling have been applied to each marine mammal species independently and, where quantitative assessment is possible, the density estimate used to predict the number of individuals at risk, will be specific to each marine mammal species (e.g. Table 10.45). The percentage of each marine mammal species at risk has been assessed against the UK portion of the species-specific MU reference population, as well as the entire species-specific MU (where relevant) (e.g. Table 10.45).</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers acknowledge Section 11.5 and Appendix A: Draft Schedule of Mitigation and Commitments within the Scoping Report that note the Embedded Mitigation measures relevant to marine mammals. The Scottish Ministers, in line with the NatureScot EIA response, recommend the SMWWC be used to minimise disturbance to marine mammals, and if possible, night vision binoculars are used in poor visibility at night. Mitigation used for marine mammals should also be applied to basking sharks.</p> <p>The Scottish Ministers advise the Developer that if Uncrewed Surface Vehicles or Autonomous Underwater Vehicles are to be used, to consult with NatureScot to agree on appropriate mitigation for basking sharks and marine mammals.</p>	<p>Section 10.9 details proposed Embedded Mitigation measures. The Applicant confirms that the SMWWC is included within the Vessel Management Plan. Mitigation proposed can also be applied to basking shark (outline MMMP).</p> <p>The Applicant notes the advice regarding the use of night vision binoculars. The Applicant highlights that the use of infrared (IR) night time vision technology for mitigation purposes remains in its early stages. Ocean Science Consulting (OSC, 2025) has conducted preliminary research and field trials of night vision systems during marine mammal observations, which yielded unsatisfactory results. Further, thermal IR cannot detect animals subsurface. As such, this methodology will not be used and has not been suggested as a mitigation tool.</p> <p>The Applicant notes the advice regarding Unmanned Surface Vehicles (USVs) and Autonomous Underwater Vehicles (AUVs). The Applicant confirms that there is no plan to use USVs or AUVs at the time of writing. Should these vessel types be selected for use at a later stage, the Applicant will consult with NatureScot and MD-LOT to agree mitigation required, and to submit relevant EPS licences.</p>
		<p>The Scottish Ministers acknowledge the approach to the cumulative assessment noted in Section 11.9 of the Scoping Report. The Scottish Ministers highlight the NatureScot EIA response and advise that consideration should be given for a year on either side of the Proposed Development, focusing on both the temporal and spatial overlap.</p>	<p>The assessment of cumulative effects, taking into account a year overlap on both sides, on marine mammals is carried out in line with the methodology presented in Section 10.8, as described in the Bowdun EIA Scoping Report.</p>

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		<p>The Scottish Ministers, in line with the NatureScot EIA response, agree that transboundary impacts can be scoped out from further consideration within the Offshore EIA Report, as suggested by the Developer in Section 11.10 and Appendix B: Transboundary Screening in the Scoping Report.</p>	<p>Transboundary impacts for marine mammals have not been considered further within the Offshore EIA Report after being scoped out in the Bowdun EIA Scoping Report.</p>
<p>27/02/2026</p>	<p>MD-LOT, NatureScot Email Consultation after being provided the baseline reports.</p>	<p>NatureScot provided feedback on the baseline reports (Volume 3, Technical Appendix 10.1: Marine Mammals Technical Report, Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report and Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). NatureScot advised on the following: quantitative use of DAS wherever possible – with qualitative where it is not, using the highest density model, bottlenose dolphin density, management units of grey seals and the presentation on densities within the final application.</p>	<p>The Applicant notes the advice from NatureScot on the baseline reports.</p>

10.5 Data Sources

10.5.1 Marine mammal data sources have been reviewed and analysed to inform the marine mammal baseline. In addition, consultation with the Marine Directorate, NatureScot and Scottish ministers has been undertaken to aid the collection of baseline information (Section 10.4).

Desktop Study

10.5.2 Information on marine mammals within the Marine Mammal Study Area was collected through a detailed desktop review of existing studies and datasets which are summarised in Table 10.13.

10.5.3 The baseline was characterised using both the literature review of the reports and numerical modelling using the datasets. The Marine Mammal Baseline Report (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report) includes a summary of all datasets and the full details of the analysis undertaken to develop the marine mammal baseline.

Table 10.13: Summary of Key Data Sources Reviewed

Title	Source	Extent	Year	Author
East Coast Scotland Marine Mammal Acoustic Array Surveys (ECOMMAS)	The Scottish Government	East Scotland	2025	Marine Directorate – Science Evidence Data and Digital (MD-SEDD)
Sympatric Seals, Satellite Tracking and Protected Areas: Updated Habitat-Based At Sea Distribution Maps for Harbour and Grey Seals	The Scottish Government	UK	2025	Carter <i>et al.</i>
Spatial models of cetacean density in European Atlantic waters based on SCANS IV summer 2022 survey data	Institute for Terrestrial and Aquatic Wildlife Research, University of Veterinary Medicine Hannover,	European Atlantic waters, North Sea	2025	Gilles <i>et al.</i>
Whale and Dolphin Conservation (WDC) Sightings Network	Whale and Dolphin Conservation	UK (2005 – present)	2025	WDC
Ossian Offshore Wind Farm (OWF), Array EIA Report, Chapter 10: Marine Mammals	Ossian OWF Limited	UK	2024	Ossian Offshore Wind Farm Limited (OWFL)
ORCA, The State of Cetaceans 2024	ORCA	UK	2024	ORCA
Site Condition Monitoring of	NatureScot	East Scotland	2024	Cheney <i>et al.</i>

Title	Source	Extent	Year	Author
bottlenose dolphins within the Moray Firth Special Area of Conservation 2017-2022				
Scottish Marine Animal Stranding Scheme (SMASS) Database	The Scottish Government	Scotland	2023	Brownlow <i>et al.</i>
Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2022 from the SCANS IV Aerial and Shipboard Surveys	SCANS IV	European Atlantic waters, North Sea	2023	Gilles <i>et al.</i>
Morven Offshore Wind Array Project EIA Scoping Report	Morven Offshore Wind Limited	UK	2023	Morven Offshore Wind Farm Limited
Scientific Advice on Matters Related to the Management of Seal Populations: 2022	SCOS	UK	2023	SCOS
Sympatric Seals Satellite Tracking and Protected Areas: Habitat-Based Distribution for Conservation and Management	Frontiers in Marine Science	UK	2022	Carter <i>et al.</i>
Updated Abundance Estimates for cetacean MUs in UK waters	IAMMWG	UK	2022	IAMMWG
Modelled Density Surfaces of Cetaceans in European Atlantic Waters in Summer 2016 from the SCANS III Aerial and Shipboard Surveys	University of St. Andrews	European Atlantic waters	2022	Lacey <i>et al.</i>
Production of Seabird and Marine Mammal Distribution Models for the East of Scotland	The Scottish Government	East Scotland	2022	Paxton <i>et al.</i>
Scientific Advice on Matters Related to the Management of Seal Populations: 2021	SCOS	UK	2022	SCOS

Title	Source	Extent	Year	Author
Berwick Bank Wind Farm Offshore EIA Report, Chapter 10 Marine Mammals	SSE Renewables	UK	2022	SSE Renewables
Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2016 from the SCANS III Aerial and Shipboard Surveys. Revised June 2021.	SCANS III	European Atlantic waters	2021	Hammond <i>et al.</i>
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters	The Scottish Government	UK	2020	Hague <i>et al.</i>
Distribution Maps of Cetacean and Seabird Populations in the North-East Atlantic	Journal of Applied Ecology	North-East Atlantic	2020	Waggitt <i>et al.</i>
Neart na Gaoithe OWF Environmental Statement (ES), Chapter 13 Marine Mammals	Neart na Gaoithe OWF	UK	2019	Mainstream Renewable Power
The Identification of Discrete and Persistent Areas of Relatively High Harbour Porpoise Density in the Wider UK Marine Area	Joint Nature Conservation Committee (JNCC)	UK	2015	Heinänen and Skov
Seagreen Firth of Forth Round 3 Zone Marine Mammal Surveys	Seagreen Alpha and Bravo OWFs (have since been renamed to Seagreen 1 and Seagreen 1A)	UK	2012	Sparling
Analysis of The Crown Estate Aerial Survey Data for Marine Mammals for the Forth and Tay Offshore Wind Developers Group Region	Sea Mammal Research Unit (SMRU)	UK	2011	Grellier and Lacey

Identification of Designated Sites

10.5.4 A three-step process was used to identify all designated sites within the Marine Mammal Study Areas which include marine mammals as Qualifying Features of

those sites that could be affected by the construction, O&M, and decommissioning phases of the Proposed Development. This process is described below:

- Step 1: All marine mammal designated sites of international, national, and local importance within the Regional Marine Mammal Study Area were identified using JNCC (2023) and NatureScot (2023a).
- Step 2: Information was compiled on the relevant marine mammal features for each of these sites using data in the public domain (JNCC, 2023).
- Step 3: Using the above information and professional judgement, sites were included for further consideration if:
 - a marine mammal designated site directly overlapped with the Proposed Development and therefore has the potential to be directly affected by the Proposed Development; or
 - marine mammal designated sites and/or Qualifying Features were located within an area where impacts associated with the Proposed Development could affect marine mammals directly or indirectly; or
 - a marine mammal designated site and/or Qualifying Features are located within the Regional Marine Mammal Study Area and have a potential for connectivity with the Proposed Development (see Table 10.16 and Figure 10.3 for all sites identified).

Site-Specific Surveys

- 10.5.5 Site-specific surveys were undertaken, to inform this assessment. A summary of the relevant survey is outlined in Table 10.14.
- 10.5.6 A DAS programme was undertaken by APEM Limited, which was flown across the ScotWind E3 POA (as defined in the SMP for Offshore Wind Energy (Scottish Government, 2020)). The DAS covered the original E3 POA plus a 12 km buffer(the buffer was extended to surround the Site Boundary); between April and August the coverage of DAS flights extended west to the Aberdeenshire coast (see Figure 4.1 of the Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). DAS flights commenced in March 2022 and were undertaken monthly, with a total of 24 months of data collected up until February 2024.
- 10.5.7 Full details of the survey methodology can be found in Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report.

Table 10.14: Summary of Site-Specific Survey Data

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date
DAS	Across the Array Area	24 months of surveys with a total 408 survey transects	APEM Limited	2022 - 2024

10.6 Baseline Environment

Overview of Baseline Environment

- 10.6.1 Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report, includes full details of the analysis undertaken to develop the marine mammal baseline and information on species ecology, distribution, seasonality, density and abundance.
- 10.6.2 The baseline found that the northern North Sea supports several different marine mammal species with internationally important populations occurring within the vicinity of the Proposed Development. Marine mammals identified with sufficiently robust data to enable quantitative assessment include:
- harbour porpoise;
 - bottlenose dolphin;
 - white-beaked dolphin;
 - minke whale;
 - grey seal; and
 - harbour seal.
- 10.6.3 Risso's dolphin, humpback whale and fin whale are also included for assessment; however, due to a lack of population density estimates, they have been assessed qualitatively (see Paragraph 10.2.2). A summary of the species accounts and available densities that have been taken forward for the quantitative or qualitative assessment are summarised below and detailed in Table 10.15.

Harbour Porpoise

- 10.6.4 Harbour porpoise accounted for the highest number of sightings across all species in the Bowdun site-specific DAS, with a total of 2,412 animals recorded across 24 months (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). Across most nearby development site-specific datasets, harbour porpoise counts were consistently higher during summer (Seagreen Wind Energy Limited, 2018; Morven Offshore Wind Limited, 2023; Ossian OWFL, 2024). IAMMWG (2022) presented estimated abundance for the North Sea D (NS-D) as 346,601 individuals. SCANS IV data estimated the density in block NS-D, where the Proposed Development is located, as 0.599 animals per km² (Gilles *et al.*, 2023). Site-specific design-based modelled estimates from the DAS provided an annual mean encounter rate of 0.635 animals per km², and the model-based density was estimated as 0.580 animals per km². Gilles *et al.* (2025) density surface estimates based on SCANS IV data estimates 0.230 animals per km² for the Local Marine Mammal Study Area. Therefore, the DAS site-specific design-based modelled density estimate is considered to be the most appropriate to inform impact assessments as it is the most precautionary, and the density of 0.635 animals per km² was taken forward to the assessment (Table 10.15).

Bottlenose Dolphin

- 10.6.5 Bottlenose dolphin were recorded during the Bowdun site-specific DAS, with a total of 12 sightings across 24 months within April and July only (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). Across datasets, bottlenose dolphin counts were consistently not recorded year-round. IAMMWG (2022) published the most up to date bottlenose dolphin population estimate for Coastal East Scotland MU of 226 individuals, and 2,022 in the GNS MU (1,885 for the UK portion of the GNS MU). There were no bottlenose dolphin sightings in block NS-D during the SCANS IV survey, and therefore, SCANS IV density values for bottlenose dolphin within this block are not available (Gilles *et al.*, 2023). Due to the low number of sightings of bottlenose dolphin in the DAS, design and model-based density and abundance estimates for bottlenose dolphin are not available. Density surface estimates derived from Lacey *et al.* (2022) are the most precautionary and are therefore considered more appropriate to use to reflect densities of bottlenose dolphin in offshore waters where the Proposed Development is located and a density of 0.007 animals per km² was taken forward to the assessment (Table 10.15).

White-beaked Dolphin

- 10.6.6 The white-beaked dolphin is the second most numerous cetacean in the North Sea. It is recorded more frequently in the western sector of the central and northern North Sea and across western Scotland and is generally sighted in small groups of three to four animals (Reid *et al.*, 2003; ASCOBANS, 2016; Schick *et al.* 2020). White-beaked dolphin was recorded during the site-specific DAS, with a total of 291 sightings across 24 months, with the majority sighted during May to September (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). Across datasets, white-beaked dolphin counts were consistently higher during the summer, autumn and winter months. IAMMWG (2022) estimated the abundance of the CGNS MU as 43,951 animals. SCANS IV data estimated the density in block NS-D where the Proposed Development is located, as 0.0799 white-beaked dolphin per km² (Gilles *et al.*, 2023). Gilles *et al.* (2025) density surface estimates gave a mean density estimate of 0.071 animals per km². Site-specific design-based modelled estimates from the DAS provided a design-based density of 0.168 animals per km². The model-based approach provided a lower estimated density, and this is also not considered reliable, due to the low predictive power across all species, but in particular white-beaked dolphin. Therefore, SCANS III density surface estimates derived from Lacey *et al.* (2022) are deemed most appropriate precautionary estimate for informing impact assessments. The density of 0.155 animals per km² was taken forward to the assessment (Table 10.15).

Risso's Dolphin

- 10.6.7 Risso's dolphin are frequently observed along the west coast of Scotland and the Outer Hebrides, rather than the waters adjacent to the east coast of Scotland (Evans *et al.* 2003; Hodgins *et al.*, 2024). Risso's dolphin was recorded during the site-specific DAS, with a total of 11 sightings across 24 months, with the majority sighted within October to January (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). Risso's dolphin have been sighted just

north of the Local Marine Mammal Study Area near Peterhead and within the Moray Firth but are considered to be a rare visitor (Couzens *et al.*, 2017; North East Scotland Biological Records Centre, 2025). There are limited abundance and density data for Risso's dolphin in East Scottish waters. No density estimates are available for Risso's dolphin in SCANS III, SCANS IV or any neighbouring DAS (Table 10.15). Due to the lack of population density estimates (as stated in Paragraph 10.6.3) Risso's dolphin has been assessed qualitatively in Section 10.10.

Minke Whale

- 10.6.8 Minke whale is the most frequently sighted mysticete species in UK waters and is particularly common around the Northern Isles and in regions of the North Sea (Weir *et al.*, 2001; Robinson *et al.*, 2007; NatureScot, 2024b). Across adjacent site-specific datasets, minke whale counts varied, but 42 were sighted during the Bowdun site-specific DAS. The abundance of minke whale in the CGNS MU is 20,118 animals (IAMMWG, 2022). SCANS IV data estimated the density in block NS-D, where the Proposed Development is located, as 0.0419 animals per km² (Gilles *et al.*, 2023). Gilles *et al.* 2025 density surface estimate for minke whale are the most recent and the density estimate for Local Marine Mammal Study Area is considered more representative of regional conditions and therefore more suitable to inform impact assessments. The density estimate of 0.030 animals per km² was taken forward to the assessment (Table 10.15).

Fin Whale

- 10.6.9 In the North Atlantic, fin whale predominately inhabits deep offshore waters beyond the continental shelf edge, favouring depths between 200 m and 2,000 m (Druon *et al.*, 2012). In UK waters, they are more frequently encountered off the west coast (particularly around the Hebrides and deep channels like the Rockall Trough), but occasional sightings have been reported in the North Sea (Bosseaus *et al.*, 2011; Embling, 2008). Fin whale have been recorded in the Moray Firth, Aberdeen coast, and Firths of Forth and Tay (Brownlow *et al.*, 2023). Fin whale was not recorded during the Bowdun DAS or in adjacent surveys. There are limited abundance and density data for fin whale in Scottish waters. No density estimates are available for fin whale in SCANS III, SCANS IV and any neighbouring DAS (Table 10.15). Due to the lack of population density estimates (as stated in Paragraph 10.6.3), fin whale has been assessed qualitatively in Section 10.10.

Humpback Whale

- 10.6.10 Humpback whales travel long annual migration distances and individuals in Scottish waters have been matched with both recovering (western North Atlantic) and non-recovering (Cape Verde) breeding populations (Rizzo and Schulte, 2009; Ryan *et al.*, 2022). There are limited abundance and density data for humpback whale in Scottish Offshore and Territorial Waters. However, there has been an increased recording of this species in Scotland in recent years (Hague, 2023; O'Neil *et al.*, 2019). No density numbers were available for humpback whales in SCANS III, SCANS IV or any neighbouring DAS (Table 10.15).

Due to the lack of population density estimates (as stated in Paragraph 10.6.3), humpback whale has been assessed qualitatively in Section 10.10.

Grey Seal

10.6.11 Grey seals are found around the coast of the UK, including in Scottish coastal waters (Galatius *et al.*, 2020; SCOS, 2025). Grey seals were observed in high numbers during site-specific DAS, with no clear temporal trends visible across monthly surveys. Based on adjacent survey sightings from Ossian OWF, grey seal was most abundant in summer (Stevens, 2023). The UK total grey seal population size at the start of the 2022 breeding season was estimated to be 162,000 grey seal, of which 129,100 (approximately 80%) were in Scotland (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). The latest population estimate for the entire East Scotland SMU (scaled to account for those at sea at the time of the count) is 10,784 grey seal, based on 2016 to 2019 survey counts (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). The latest population estimate for the entire North Coast & Orkney SMU (scaled to account for those at sea at the time of the count) is 34,191 grey seal, based on 2016 to 2019 survey counts (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). The latest population estimate for the entire Moray Firth SMU (scaled to account for those at sea at the time of the count) is 7,380 grey seal, based on 2021 survey counts (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). The site-specific DAS design-based density estimate within the Local Marine Mammal Study Area was 0.120 animals per km². The Carter *et al.* (2022) density estimate for the Local Marine Mammal Study Area is 0.56 animals per km² is taken forward for assessment as it is more precautionary than the equivalent density estimate for grey seal derived from Carter *et al.* (2025) although this represents more recent data (Table 10.15).

Harbour Seal

10.6.12 Harbour seal is widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles (SCOS, 2025). On the east coast, their distribution is more restricted, with concentrations in the major estuaries of the Firths of Forth and Tay, and the Moray Firth. No clear patterns in seasonality of harbour seal can be concluded based on DAS or historic survey sightings due to low numbers of animals identified to species level. The UK total harbour seal population was estimated at 42,854 harbour seal in 2021 (Volume 3: Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). Major declines have been documented in several harbour seal populations along the east coast of England and around Scotland (SCOS, 2022). A sudden change in the East Scotland SMU population trend was observed in 2002, and the nature of this change remains unknown (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). The population estimate for the entire East Scotland SMU (scaled to account for those at sea at the time of the count) is 364 harbour seal, based on 2021 survey counts (SCOS, 2022). The latest population estimate

for the entire Moray Firth seal SMU (scaled to account for those at sea at the time of the count) is 958 harbour seal based on 2021 survey counts (SCOS, 2022). Mean harbour seal at sea usage within the Local Marine Mammal Study Area is very low, with mean usage of 0.203 animals per 5 x 5 m grid cell, equating to a density of 0.008 animals per km² (Carter *et al.*, 2025). There were only three harbour seal recorded during the DAS site-specific survey, these numbers were too low to calculate design-based or model-based density estimates for this species. The density of 0.009 animals per km² based on Carter *et al.* (2025) was taken forward to the assessment as this is the latest density estimate from a declining population (Table 10.15).

Table 10.15: Summary of Marine Mammal Receptors to be Considered Quantitatively Together with Relevant Densities, and Reference Populations

Species	Density (Animals per km ²)	MU	Population in MU	Population in the UK Portion of MU
Harbour porpoise	0.635 ¹	North Sea MU	346,601 (IAMMWG, 2022)	159,632 (IAMMWG, 2022)
Bottlenose dolphin	0.007 ²	Coastal East Scotland MU and GNS MU	226 + 2,022 = 2,248	226+ 1,885 = 2,111 (IAMMWG, 2022; Cheney <i>et al.</i> , 2024)
White-beaked dolphin	0.155 ²	Celtic and GNS MU	43,951 (IAMMWG, 2022)	34,025 (IAMMWG, 2022)
Minke whale	0.030 ³	Celtic and GNS MU	20,118 (IAMMWG, 2022)	10,288 (IAMMWG, 2022)
Grey seal	0.56 ⁴	North Coast and Orkney SMU, Moray Firth SMU, and East Scotland SMU	34,191 + 7,380 + 10,784 = 52,355	N/A
Harbour seal	0.009 ⁵	Moray Firth and East Scotland SMU	958 + 364 = 1,322	N/A
Risso's dolphin, fin whale, humpback whale,		Qualitative assessment		

¹Design-based (absolute) density estimate, from DAS.

²Density based on Lacey *et al.*, (2022)

³Density based on Gilles *et al.* (2025)

⁴Density based on Carter *et al.* (2022)

⁵Density based on Carter *et al.* (2025)

Designated Sites

- 10.6.13 Using the methodology detailed in Section 10.5, all designated sites located within the Regional Marine Mammal Study Area were detailed in Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report. A list of sites that warrant further information was developed by considering steps 2 and 3 (in Section 10.5).
- 10.6.14 Designated sites and relevant marine mammal Qualifying Features are summarised in Table 10.16 and presented in Figure 10.3. The distance between the project and designated sites was based on the closest marine route to the Proposed Development.
- 10.6.15 Scoping Opinion (MD-LOT, 2024a) and LSE screening opinions (MD-LOT, 2024b) indicated that the key MPAs that should be considered for assessment, were the Firth of Tay and Eden Estuary Special Area of Conservation (SAC), Isle of May SAC, Berwickshire and North Northumberland Coast SAC, Moray Firth SAC and Southern North Sea SAC.
- 10.6.16 In addition, Dornoch Firth and Morrich More SAC have been included due to telemetry data (Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report: Annex A; Marwood and Stevens, 2024). Nine harbour seals showed usage in the Local Marine Mammal Study Area. All nine of these individuals showed connectivity with the Firth of Tay and Eden Estuary SAC (where they were tagged) in the East Scotland SMU and the Local Marine Mammal Study Area (Figure 6.32 of the Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report). None of these individuals showed connectivity with harbour seal SACs outside of the East Scotland SMU.

Table 10.16: Designated Sites and Relevant Qualifying Features for Marine Mammals Within the Regional Marine Mammal Study Area

Designated Site	Closest Distance to Array Area (km)	Relevant Qualifying Feature(s)
Southern Trench ncMPA	35.9	Minke whale
Firth of Tay and Eden Estuary SAC	89.1	Harbour seal
Isle of May SAC	104.5	Grey seal
Berwickshire and North Northumberland Coast SAC	116.2	Grey seal
Moray Firth SAC	157.5	Bottlenose dolphin
Dornoch Firth and Morrich More SAC	195.4	Harbour seal
Southern North Sea SAC	203.4	Harbour porpoise

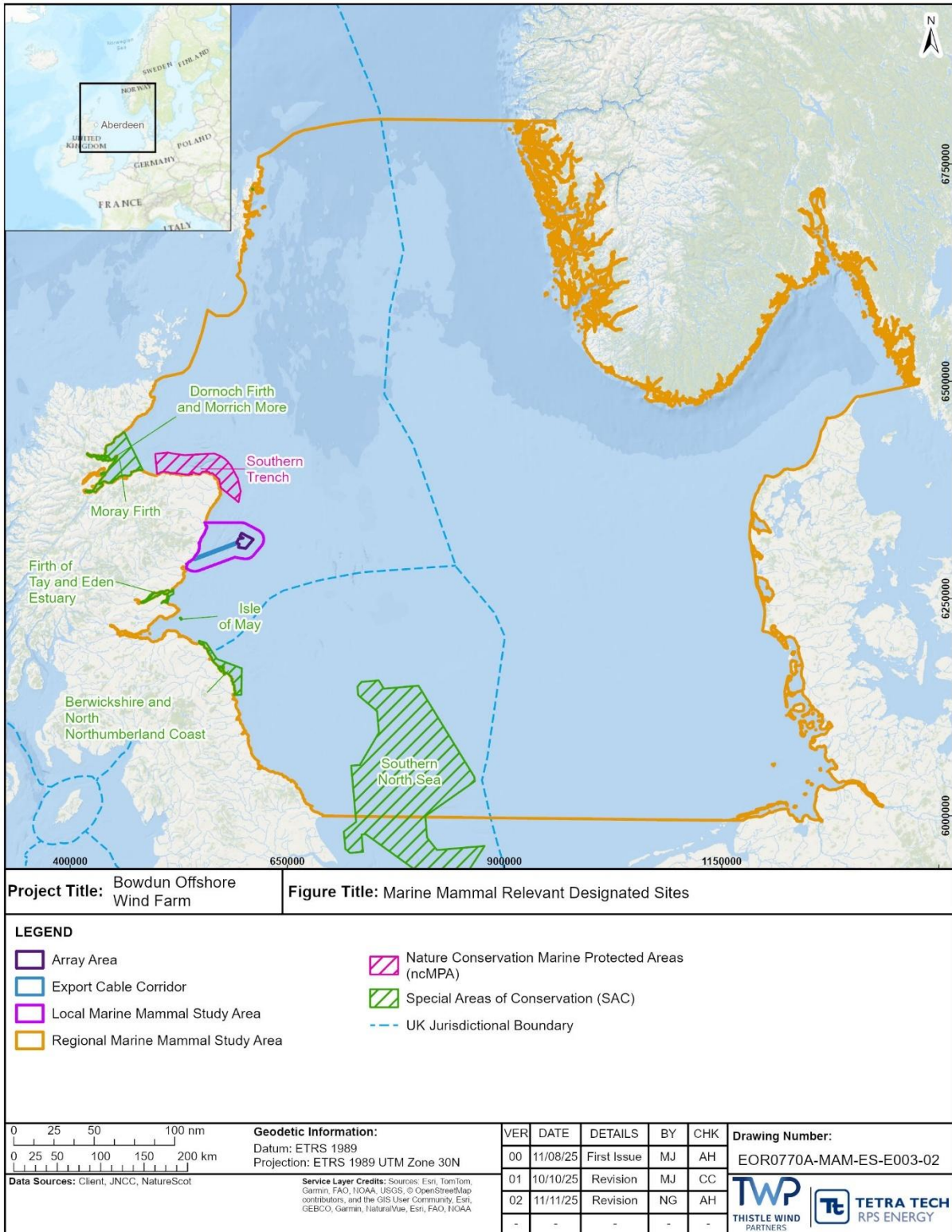


Figure 10.3: Marine Mammal Relevant Designated Sites

Important Ecological Features

- 10.6.17 IEFs for the purposes of the marine mammal EIA have been identified using best practice guidelines (Chartered Institute for Ecology and Environmental Management (CIEEM), 2024). The potential impacts of the Proposed Development which have been scoped into the assessment (see Section 10.8) have been assessed against the IEFs to determine whether or not they are significant, therefore, the IEFs assessed are those that are considered to be important and potentially impacted by the Proposed Development. Importance may be assigned due to quality or extent of habitats, habitat or species rarity or the extent to which they are threatened (CIEEM, 2022). For a species or habitats to be considered IEFs, they must have a specific biodiversity importance recognised through international or national legislation or through local, regional, or national conservation plans (e.g. Annex II Species under the Habitats Directive, OSPAR, National Biodiversity Plan or the Marine Strategy Framework Directive, Scottish PMFs and the Scottish Biodiversity list).
- 10.6.18 It should be noted that even if the impacts to marine mammals are not considered to be significant in EIA terms, all cetaceans are protected as EPS under the Habitats Regulations. Separate EPS licence applications and risk assessments will be undertaken, once all the appropriate information is collated to inform the Piling Strategy and for any UXO clearance activity. This information will also feed into the finalised MMMPs post-consent.
- 10.6.19 Table 10.17 lists all of the IEFs within the Regional Marine Mammal Study Area. All cetaceans with the potential to be affected by the Proposed Development are afforded legal protection as Annex IV(a) species under the Habitats Directive, and both the grey and harbour seal are afforded legal protection as Annex II Species under the Habitats Directive and under the Marine (Scotland) Act 2010 (see above) and are important from a conservation perspective in both international and national contexts. Therefore, the value of all marine mammal IEFs was determined to be international. The relevant species identified throughout the Regional Marine Mammal Study Area are harbour porpoise, bottlenose dolphin, white-beaked dolphin, Risso’s dolphin, minke whale, humpback whale, fin whale, grey seal and harbour seal.

Table 10.17: IEFs Within the Proposed Development Marine Mammal Study Area

IEF	Conservation Interest	Importance Within the Marine Mammal Study Area
Odontocetes		
Harbour porpoise	<ul style="list-style-type: none"> • Annex II Species that is a designated feature of Southern North Sea SAC; • EPS; • Scottish PMF; • OSPAR protected species; • International Union for Conservation of Nature (IUCN) Red List Least Concern; and • UK Biodiversity Action Plan (BAP) priority species. 	International

IEF	Conservation Interest	Importance Within the Marine Mammal Study Area
Bottlenose dolphin	<ul style="list-style-type: none"> • Annex II Species that is a designated feature of Moray Firth SAC; • EPS; • Scottish PMF; • IUCN Red List Least Concern; and • UK BAP priority species. 	International
White-beaked dolphin	<ul style="list-style-type: none"> • EPS; • Scottish PMF; • IUCN Red List Least Concern; and • UK BAP priority species. 	International
Risso's dolphin	<ul style="list-style-type: none"> • EPS; • Scottish PMF; • IUCN Red List Least Concern; and • UK BAP priority species. 	International
Mysticetes		
Minke whale	<ul style="list-style-type: none"> • Designated feature of Southern Trench ncMPA; • EPS; • Scottish PMF; • IUCN Red List Least Concern; and • UK BAP priority species. 	International
Fin whale	<ul style="list-style-type: none"> • EPS; • Scottish PMF; • IUCN Red List Vulnerable; and • UK BAP priority species. 	International
Humpback whale	<ul style="list-style-type: none"> • EPS; • IUCN Red List Least Concern; and • UK BAP priority species. 	International
Pinnipeds		
Grey seal	<ul style="list-style-type: none"> • Annex II Species that is a designated feature of Isle of May SAC and Berwickshire and North Northumberland Coast SAC; • IUCN Red List Least Concern; and • Scottish PMF. 	International
Harbour seal	<ul style="list-style-type: none"> • Annex II Species that is a designated feature of Firth of Tay and Eden Estuary SAC, Dornoch Firth and Morrich More SAC; • IUCN Red List Least Concern; and • Scottish PMF. 	International

Future Baseline Scenario

- 10.6.20 The EIA Regulations require that “a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort, on the basis of the availability of environmental information and scientific knowledge” is included within the Offshore EIA Report.
- 10.6.21 If the Proposed Development does not come forward, an assessment of the ‘without development’ future baseline conditions has also been carried out and is described within this section.
- 10.6.22 Marine mammal abundance and distribution is impacted by various anthropogenic activities (Avila *et al.*, 2018; Environment, Food and Rural Affairs Committee, 2023), including offshore developments and associated subsea noise, together with fisheries and vessel activity. According to Avila *et al.* (2018) almost all global marine mammal species (98%) were documented to be affected by at least one threat between 1991 and 2016. Bycatch in active fishing gear was the most prevalent threat for odontocetes and mysticetes, followed by pollution (solid waste), commercial hunting, and boat collisions. Pinnipeds were documented as primarily threatened by ghost-net entanglements, solid and liquid wastes, and infections (Avila *et al.*, 2018). As discussed in Volume 2, Chapter 9: Fish and Shellfish Ecology, fisheries management measures will affect marine mammal prey species, such as the recent closure of sandeel fisheries in Scottish waters (i.e. The Sandeel (Prohibition of Fishing) (Scotland) Order 2024)) which banned the fishing for sandeel from March 2024 within the Scottish zone. It is anticipated that this closure will provide wider potential benefits to the marine ecosystem including direct benefits to sandeel populations (through reduction of pressures from fishing) and indirect benefits to marine mammal species through potential increased prey availability, as sandeel is an important prey species for many marine mammal species.
- 10.6.23 Beyond the direct anthropogenic impacts, marine mammals are susceptible to non-direct effects from human activities (Avila *et al.*, 2018), such as climate change and global warming leading to rising sea temperatures. A common response of marine mammals to temperature changes is shifts in their spatial distribution, potentially modifying the ranges of certain species (e.g. white-beaked dolphin). Changes in water temperatures may also impact the life cycles of marine mammal prey species, creating discrepancies in prey abundance that affect migratory marine mammal species and those exhibiting site fidelity. Additionally, global warming could influence marine mammal survival rates by impacting reproductive success, increasing stress, and promoting pathogen infections (Albouy *et al.*, 2020). Increased storms associated with climate change pose a mortality risk to grey seal pups, from malnourishment, injuries, including being swept out to sea, and infections (Saville *et al.*, 2025).

- 10.6.24 Given that climatic changes now compound anthropogenic pressures, predicting future trajectories of marine mammal populations without comprehensive data is challenging. Monitoring is not consistently in place at relevant temporal or spatial scales for some species, especially minke whale. SCANS surveys for cetaceans are conducted infrequently, approximately every decade, leading to significant temporal gaps in data (Gilles *et al.*, 2023). Additionally, not all areas are covered in each survey, resulting in spatial gaps. Similarly, SCOS surveys for seals do not monitor every site annually, creating both spatial and temporal gaps in the data (SCOS, 2023). Some sites may be monitored more frequently than others, leading to inconsistencies in data coverage. Therefore, information presented in this section provides a summary of current and anticipated pressures. Where data are available, information about population dynamics is presented.
- 10.6.25 Any changes that may occur during the design life span of the Proposed Development have been considered in the context of both greater variability and sustained trends occurring at national and international scales in the marine environment. Whilst there is an indication that some populations are increasing (i.e. bottlenose dolphin, grey seal) or remaining stable (harbour porpoise, minke whale, white-beaked dolphin) or exhibiting regional declines (e.g. harbour seal), it is challenging to define a future trajectory of marine mammal populations. Some UK marine mammal populations have undergone periods of significant change in parts of their range, with a limited understanding of the driving factors responsible. For example, there is uncertainty about whether a reduction in pup mortality or an increase in fecundity is the cause of the recent exponential growth of grey seal in the North Sea (Russel and Hastie, 2017). Additionally, there is no appropriate monitoring at the right temporal or spatial scales to fully understand the baseline dynamics of some marine mammal populations, including all marine mammal species included in this assessment. Therefore, it is difficult to predict what marine mammal populations would look like in the future.
- 10.6.26 The results of the most recent UK assessment of Favourable Conservation Status (FCS) for each marine mammal species included in the assessment are outlined in Table 10.18.

Table 10.18: Summary of the Conservation Status of each Marine Mammal Species (FV = Favourable, XX = Unknown, + = Improving, U1 = Unfavourable – Inadequate, S = Stable, NA = Not Available)

Species	Range	Population	Habitat	Future Prospects	Overall Assessment of Conservation Status	Overall trend in Conservation Status	Reference
Harbour porpoise	FV	XX	XX	FV	XX	XX	JNCC, 2019a
Bottlenose dolphin	FV	XX	XX	XX	XX	XX	JNCC, 2019b
White-beaked dolphin	FV	XX	XX	XX	XX	XX	JNCC, 2019c
Risso's dolphin	FV	XX	XX	XX	XX	XX	JNCC, 2019d
Minke whale	FV	XX	XX	XX	XX	XX	JNCC, 2019e
Fin whale	FV	XX	XX	XX	XX	XX	JNCC, 2019f
Humpback whale	NA	NA	NA	NA	NA	NA	NA
Grey seal	FV	FV	FV	FV	FV	+	JNCC, 2019g
Harbour seal	FV	U1	XX	U1	U1	XX	JNCC, 2019h

Data Limitations and Assumptions

- 10.6.27 The marine mammal impact assessment was developed on the basis of the best available information at the time of writing. Baseline data used to underpin the assessment was drawn from a thorough desktop review of broadscale sources and site-specific surveys which are subject to temporal and spatial variability and so are likely to influence the overall conclusion of marine mammal distribution and abundance presented within this report.
- 10.6.28 The assessment of marine mammal species abundance and density is not straightforward. Primarily because they are wide-ranging and spend most of their time underwater. Each type of survey method has advantages and disadvantages, but key considerations is that the observations made are specific to the location and the time of survey. Often, these observations need to be extrapolated to understand the likely usage of area. Observations are subject to bias. When undertaken by observers, the ability of the individual to accurately count and identify animals on the transect, may be affected by observer fatigue. Further, because animals are underwater, they are not always available to be observed. Correction factors can be used to account for time underwater, however, there are limited data upon which to base these correction factors on.
- 10.6.29 Models are relied on to extrapolate the observations, and each model used is subject to a number of assumptions and choices. The compilation of a wide range of data sources where the information can be compared and contrasted, allows for the baseline data to characterise the region of interest. More information on uncertainty and assumptions made during the site-specific DAS can be found in Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report.
- 10.6.30 Whilst these data limitations and assumptions could lead to some level of uncertainty, this is overcome by adopting a precautionary approach at each stage of the assessment.

10.7 Key Parameters for Assessment

Maximum Design Scenario

- 10.7.1 The MDS identified in Table 10.19 are those parameters expected to have the potential to result in the greatest effect on identified marine mammal receptors. Any other development scenario within the Project Design Envelope (PDE), will result in the same, or less, level of environmental effect. The scenario has been selected from the details provided in Volume 1, Chapter 3: Project Description.

Table 10.19: Maximum Design Scenario Considered for Each Potential Impact as Part of the Assessment of Likely Significant Environmental Effects on Marine Mammals

Potential Impact	Phase*			MDS	Justification
	C	O	D		
Injury and disturbance from subsea noise generated during piling	✓	×	×	<p>Construction Phase</p> <p><u>Maximum temporal scenario:</u> <i>Fixed Foundations – 15 MW 4-legged jacket</i></p> <ul style="list-style-type: none"> • Number of piled jacket foundations – 67; • Maximum number of piles – 268; • Maximum pile diameter – 3.8 m; • Maximum pile length – 70 m, with final pile penetration depth of 65 m; • Maximum hammer energy – 4,500 kJ; • Maximum duration of piling per pile – 12.4 hours; • Maximum duration of piling per day – 22 hours; and • Maximum duration of piling – 3,323.3 hours (12.4 hours per day over 268 days)). <p><u>Maximum spatial scenario:</u> <i>Fixed Foundations – 25 MW monopile</i></p> <ul style="list-style-type: none"> • Number of monopile foundations – 40; • Maximum number of piles – 40; • Maximum pile diameter – 15 m; • Maximum pile length – 123 m, with final pile penetration depth of 45 m; • Maximum hammer energy – 6,250 kJ; • Maximum duration of piling per pile – 8.6 hours; • Maximum duration of piling per day (based on 2 piles installed concurrently) – 17.1 hours; and • Minimum total hours of piling – 172 hours (8.6 hours per day over 20 days). 	<p>The impact assessment for marine mammals will consider the maximum impact ranges from both single and concurrent piling scenarios. Noise modelling will estimate impact ranges for instantaneous auditory injury, accumulated auditory injury (over the duration of the installation period) and disturbance.</p> <p>Three scenarios have been chosen for modelling purposes:</p> <p><u>Maximum temporal scenario</u> The maximum temporal scenario is identified as the greatest number of days on which piling could occur based on the number of pin piles that could be installed within a 24-hour period (one per day). This utilised the 15 MW 4-legged jacket foundation option. The parameters modelled for this option will encompass the OSPs.</p> <p><u>Maximum spatial scenario</u> The maximum spatial scenario is identified as the 25 MW monopile fixed foundation option which presents the largest hammer energy and maximum spacing between concurrent piling events which would lead to the largest spatial extent of ensonification at any one time.</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<p><u>Realistic scenario:</u> <i>Fixed Foundations – 25 MW monopile</i></p> <ul style="list-style-type: none"> • Number of monopile foundations – 40; • Maximum number of piles – 40; • Maximum pile diameter – 15 m; • Maximum pile length – 123 m, with final pile penetration depth of 45 m; • Average maximum hammer energy – 6,000 kJ; • Average maximum duration of piling per pile – 4.3 hours; and • Maximum total hours of piling – 172 hours (4.3 hours per day over 40 days). <p>Concurrent piling – all three scenarios</p> <ul style="list-style-type: none"> • up to 2 vessels piling concurrently; and • minimum 1 km and maximum 20 km distance between concurrent piling events. 	<p>The parameters modelled for this option will encompass the OSPs.</p> <p><u>Realistic spatial scenario</u> The realistic spatial scenario is based on 25 MW monopile foundations, applying an average maximum hammer energy and average maximum piling duration per pile (in place of maximums) in order to provide context to the maximum spatial scenario. A key parameter in the estimation of accumulated injury is the duration of impact piling. The parameters modelled for this option will encompass the OSPs.</p> <p>Concurrent piling will be modelled in addition to single piling events. In all cases concurrent piling would lead to a larger spatial extent of ensonification in total, in comparison to a single piling event.</p> <p>Minimum spacing between concurrent piling represents the highest risk of auditory injury to animals as noise from adjacent foundations could combine to produce a greater radius of effect compared to a single piling event. This represents the MDS for concurrent piling injury impacts.</p> <p>Maximum spacing between concurrent piling represents a larger area of ensonification. This represents the MDS for concurrent piling disturbance impacts.</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
Injury and disturbance from subsea noise generated during UXO clearance	✓	×	×	UXO clearance <ul style="list-style-type: none"> Maximum realistic charge weight of UXO 227 kg (Net Explosive Quantity (NEQ)); A maximum of 40 UXOs are anticipated to require clearance (based on most probable case for the Array Area and Export Cable Corridor combined); A maximum of 2 detonations during 24 hrs; and A maximum of 40 days of UXO clearance activities (assuming one clearance per day). 	<p>Maximum number used in the MDS (reflecting the most realistic maximum design) and the maximum size of UXOs encountered within the Site Boundary is based on the UXO Hazard Assessment undertaken for the Proposed Development (PDE; 6 Alpha Associates, 2020). The actual detail of any possible UXO that may need clearance is not known at this stage.</p> <p>In accordance with the JNCC (2025a) and the UK Government’s Joint Position Statement (Department for Environment Food and Rural Affairs (DEFRA), 2025), the default clearance method will be a low noise technique.</p> <p>The MDS represents the maximum charge weight likely to require clearance.</p> <p>Noise modelling will estimate impact ranges for low order as the default, with high order impact ranges provided for context.</p>
Injury and disturbance from subsea noise generated during site-investigation surveys	✓	✓	×	Construction Phase Typical Geophysical equipment: <ul style="list-style-type: none"> Multibeam Echosounder (MBES); <ul style="list-style-type: none"> Frequency 400 kHz; Source level 225 dB re 1 µPa (rms); Side scan sonar (SSS); <ul style="list-style-type: none"> Low frequency (LF) 230 kHz; High frequency (HF) 550 kHz; Source level 210 dB re 1 µPa (rms); 	<p>Site-investigation surveys are conducted in the pre-construction phase. However, details of the specific equipment types are not yet known. The assessment will be based on literature/known acoustic characteristics associated with typical equipment used for site surveys.</p> <p>Site-investigation surveys may also be required during the O&M phase. The assessment conducted for the pre-</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<ul style="list-style-type: none"> • Parametric Sub-bottom profiler (SBP); <ul style="list-style-type: none"> • 100 kHz (primary); 4, 5, 6, 8, 10, 12 kHz selectable secondary frequencies; • Source level 248 dB re 1 µPa (rms); • 2D Ultra High-Resolution Seismic (UHRS); <ul style="list-style-type: none"> • Frequency 0.05 to 4 kHz; and • Source level 219 dB re 1 µPa (rms). Typical Geotechnical equipment: <ul style="list-style-type: none"> • Vibrocore; and • Boreholes. Geophysical and geotechnical surveys will take place during the pre-construction period, involving up to 14 vessels on site at any one time and up to 110 vessel movements (return trips) in total. <p>O&M Phase MDS based on the same geophysical and geotechnical equipment used for the construction phase. The O&M phase will last for up to 30 years.</p>	construction phase will be applied to the O&M phase as the same types of equipment are used.
Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	✓	✓	✓	<p>Construction Phase During the pre-construction phase, a total of 18 vessels will be on site at any one time resulting in a total of 140 return trips.</p> <p>During the construction phase, a total of 16 vessels will be on site in the Export Cable Corridor at any one time, with an estimated 449 return trips in total. A total of 25 vessels will be on site in the Array Area at any one time with an estimated 1,671 return trips in total.</p> <p>Vessel types include installation (jack-up/dynamic positioning (DP)), cargo barge/heavy transport, scour protection</p>	<p>Maximum numbers of vessels on site at any one time and largest numbers of return trips during each phase will result in the greatest potential impact.</p> <p>Range of other activities producing underwater noise, including maximum timescales were also included.</p> <p>Drilling noise will be assessed using an appropriate source level and modelled as continuous noise over a 24-hour period.</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<p>installation, grouting, drilling, support (dive/trenching, including Service Operation Vessel (SOV)), tug/anchor, cable laying (and burial), guard, survey, crew transfer vessels (CTVs), sandwave clearance, pre-lay grapnel run (PLGR), rock dumping, boulder clearance, UXO clearance, and micro-tunnelling or trenchless technique installation e.g. Horizontal Directional Drilling (HDD) support vessels.</p> <p>Other noise producing activities, include drilling activities (if required):</p> <ul style="list-style-type: none"> drilling of up to a maximum of 32.5 hours per pile over a maximum realistic duration of 268 days (15 MW 4-leg piled jacket). <p>O&M Phase For the Array Area, a total of 12 vessels will be on site at any one time, over the duration of O&M phase (up to 30 years) resulting in a total of up to 588 return trips per year. In addition to this, a further number of vessels will undertake another 146 return trips spread over entire 30-year O&M phase. Vessels will be associated with a range of O&M activities, including routine inspections, repairs and replacements, removal of marine growth and painting.</p> <p>For the Export Cable Corridor, a total of 8 vessels will be on site at any one time, over the duration of O&M phase (up to 30 years) resulting in a total of up to 125 return trips per year. In addition to this, a further number of vessels will undertake another 114 return trips spread over entire 30-year O&M phase. Vessels will be associated with a range of O&M activities, including routine inspections, repairs and replacements, removal of marine growth and painting.</p>	<p>Injury and disturbance from vessel use during UXO clearance and site-investigation surveys is included under this potential impact pathway.</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<p>Decommissioning Phase A Decommissioning Programme will be submitted to MD-LOT for consultation and approval. The Decommissioning Programme will be updated during the Project’s lifespan to take account of changing best practice and new technologies.</p> <p>The approach for decommissioning is yet to be determined, however, for the purposes of this MDS it is assumed there will be a range of vessels used for decommissioning activities such as removal of foundations, cables and cable protection. Noise from vessels assumed to be as per vessel activity described for construction phase.</p>	
Injury and disturbance from subsea noise generated by Wind Turbine operation	x	✓	x	<p>O&M Phase Fixed foundation monopile/3-legged jacket/4-legged jacket with a maximum number of 67 Wind Turbines.</p> <p>The O&M phase will last for up to 30 years.</p>	<p>Most of the O&M phase noise will be generated from above the water structures (e.g. tower, nacelle, Wind Turbine and rotors).</p> <p>The MDS for monopile and jacket foundations reflects the maximum scale of the array (based upon the maximum number of Wind Turbines).</p>
Injury to marine mammals due to collision with vessels	✓	✓	✓	<p>Construction Phase As described for injury and disturbance from subsea noise generated by vessel use.</p> <p>O&M Phase As described for injury and disturbance from subsea noise generated by vessel use.</p> <p>Decommissioning Phase As described for injury and disturbance from subsea noise generated by vessel use.</p>	<p>Maximum numbers of vessels on site at any one time and the largest numbers of return trips during each phase will result in the greatest potential impact.</p>

Potential Impact	Phase*			MDS	Justification
	C	O	D		
Effects on marine mammals due to altered prey availability	✓	✓	✓	<p>Construction Phase</p> <ul style="list-style-type: none"> Up to 19,414,805 m² of subtidal temporary habitat loss and/or disturbance due to trenchless technique installation e.g. HDD exit pit excavation, sandwave clearance, sandwave clearance material deposition, cable installation (including boulder clearance) and jack-up events An additional 13,987 m² of temporary habitat loss and/or disturbance could occur due to crater formation from the clearance of UXO. Up to 2,251,000 m² (0.77% of the total area of the Site Boundary) of long-term subtidal habitat loss due to Offshore Infrastructure installed in the construction phase, which will persist into the O&M phase. Introduction of up to 2,705,020 m² of hard structure surface area installed throughout the construction phase which will persist into the O&M phase. Effects on fish and shellfish receptors due to underwater noise from piling, UXO clearance, site-investigation surveys and vessel noise and other noise producing activities. Effects on fish and shellfish receptors from Suspended Sediment Concentrations (SSC) from drill arising, Inter-Array Cable (IAC) installation, Offshore Export Cable installation, sandwave clearance, trenchless technique installation e.g. HDD exit pit excavation and HDD drilling fluid release (at landfall). <p>O&M Phase</p> <ul style="list-style-type: none"> A total of up to 11,688,813 m² of temporary subtidal habitat loss (up to 4.01% of the total area of the Site Boundary) and/or disturbance due to jack-up events and 	MDS as described for fish and shellfish receptors (Volume 2, Chapter 9: Fish and Shellfish Ecology) will result in the greatest potential impact on prey availability.

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<p>disturbance caused by reburial of IACs, Interconnector Cables and Offshore Export Cables.</p> <ul style="list-style-type: none"> Up to 2,705,020 m² of hard substrate will be installed in the construction phase could be colonised by benthic species; Effects on fish and shellfish ecology due to SSCs from drilling for pile installation, IAC installation, Offshore Export Cable installation, sandwave clearance, trenchless technique installation e.g. HDD exit pit excavation and HDD drilling fluid release (at landfall) Effects on fish and shellfish ecology due to EMFs from subsea electrical cabling due to presence of: <ul style="list-style-type: none"> up to 151 km of 132 kV IACs up to 36 km of 275 kV Interconnector cables up to 210 km of 275 kV Offshore Export Cables Effects on fish and shellfish receptors due to underwater noise from site-investigation surveys, operational noise from Wind Turbines, and vessel noise and other noise producing activities. <p>Decommissioning Phase A Decommissioning Programme will be submitted to MD-LOT for consultation and approval. The Decommissioning Programme will be updated during the Project’s lifespan to take account of changing best practice and new technologies.</p> <p>The approach for decommissioning is yet to be determined, however, for the purposes of this MDS it has been assumed that all Scour Protection, cable protection, and cable crossing protection will be left <i>in situ</i>. Therefore, up to 2,232,100 m² (up to 0.79% of the total area of the Site Boundary) of long-term habitat loss will persist past the decommissioning.</p>	

* Proposed Development Phase refers to construction (C), O&M (O) and decommissioning (D).

Impacts Scoped Out of the Assessment

- 10.7.2 The Scoping Workshop (see Table 10.12) was used to facilitate stakeholder engagement on topics to be scoped out of the assessment.
- 10.7.3 On the basis of the baseline environment and the Project Description outlined in Volume 1, Chapter 3: Project Description, a number of impacts are scoped out of the assessment for marine mammals. These impacts were proposed to be scoped out in the Bowdun Offshore Scoping Report (BOWFL, 2024) and agreed (MD-LOT and NatureScot) as there were no concerns raised by key consultees within the Scoping Opinion (MD-LOT, 2024a).
- 10.7.4 These impacts are outlined, together with a justification for scoping it out, in Table 10.20.

Table 10.20: Impacts Scoped Out of the Assessment for Marine Mammals (Tick Confirms the Impact is Scoped Out)

Potential Impact	Phase*			Justification
	C	O&M	D	
Accidental pollution to the surrounding environment	✓	✓	✓	<p>There is a risk of accidental pollution from vessels and equipment during all three phases of development. However, this risk is mitigated by the implementation of measures set out in standard post-consent plans, such as an Outline Environmental Management Plan (EMP) (Volume 4, Appendix 24: Outline Environmental Management Plan), which will include a Marine Pollution Contingency Plan (MPCP) (Volume 4, Appendix 25: Marine Pollution Contingency Plan). The Outline EMP (Volume 4, Appendix 24: Outline Environmental Management Plan) and MPCP (Volume 4, Appendix 24: Outline Environmental Management Plan, Annex A, Marine Pollution Contingency Plan) will include planning for accidental spills, address all potential contaminants that could be released, and include key emergency contact details. They will also set out good industry practice and relevant guidelines for preventing pollution at sea (such as those from the OSPAR, International Maritime Organisation (IMO), and the International Convention for the Prevention of pollution from Ships).</p> <p>Thus, it is unlikely that accidental pollution will occur. In the unlikely event that it did, the magnitude will be minimised through measures outlined in plans such as the MPCP. Therefore, it was proposed within the Scoping Report (BOWFL, 2024) that this impact is scoped out of further consideration within the Offshore EIA Report.</p>
Increased SSCs and associated deposition	✓	✓	✓	<p>Increases in SSCs and associated deposition could occur due to activities in all phases of development that disturb the seabed. This could have both direct and indirect impacts on marine mammals. As prey species could potentially be affected by this impact, marine mammals could be indirectly affected as a result. However, impacts on prey species are already scoped into the assessment.</p> <p>Direct impacts to marine mammals include reduced visibility and, thus, potentially reduced foraging ability.</p>

Potential Impact	Phase*			Justification
	C	O&M	D	
				<p>However, marine mammals are well known to forage in tidal areas with turbid water and poor visibility conditions. Many of the species scoped into the assessment (such as bottlenose dolphin, harbour porpoise, grey seal, and harbour seal) commonly frequent coastal areas, so would likely be tolerant of turbid and silty water. Harbour seal and harbour porpoise have been documented foraging in areas with high tidal flows (Hastie <i>et al.</i>, 2016; Pierpoint, 2008). Therefore, low light levels and turbid waters associated with SSCs are unlikely to impair foraging success. Furthermore, marine mammals can navigate and forage using mechanisms other than eyesight. For example, seals can detect water movements and hydrodynamic trails with their mystacial vibrissae (i.e. whiskers); whilst odontocetes primarily use echolocation to navigate and find food in darkness (Grant <i>et al.</i>, 2013; Marriott <i>et al.</i>, 2013; Schulte-Pelkum <i>et al.</i>, 2007).</p> <p>Although increased SSCs may arise during activities at the Proposed Development, the maximum impact range is expected to be highly localised, and sediments will rapidly dissipate over one spring tidal excursion. In addition to the large natural variability in SSCs within the Local Marine Mammal Study Area and the adaptations of marine mammals to silty, turbid water, it was proposed in the Scoping Report (BOWFL, 2024) that this impact will be scoped out of further consideration within the Offshore EIA Report for all species.</p>
Injury to marine mammals due to entanglement	✓	✓	✓	<p>Injury to marine mammals due to entanglement is a potential impact when OWFs include floating Wind Turbines. The potential hazards from floating Wind Turbines include mooring lines and dynamic cables where individuals could become entangled or entrapped leading to the animal's mortality. This entanglement risk can be categorised into two types: primary and secondary (SEER, 2022):</p> <ul style="list-style-type: none"> • Primary entanglement refers to the direct entanglement of marine life with mooring lines. • Secondary entanglement occurs when marine life becomes entangled with marine debris, such as derelict fishing gear, that has become snagged on a mooring line (SEER, 2022). <p>The Proposed Development only considers fixed Wind Turbines without any mooring lines (see Volume 1 Chapters 3: Project Description and Table 10.19). As such, this impact has been scoped out of further consideration within the marine mammal EIA chapter.</p>

Potential Impact	Phase*			Justification
	C	O&M	D	
Impact of Electromagnetic Fields (EMF) from subsea cables on marine mammals	✓	✓	✓	<p>There are uncertainties of EMF related to marine renewable devices having Impact (either positive or negative) on marine mammals based on the data available to date, (Copping, 2018). Threshold values for EMF effects are only available for a few species (mainly elasmobranchs), leaving major uncertainties in several important taxonomic groups including cetaceans and pinnipeds. For seals, there is currently no evidence that they can detect or respond to EMF, but some species of cetaceans may be able to detect variations in magnetic fields (Normandeau Associates Inc <i>et al.</i>, 2011). The only known marine mammal to show any response to EMF is the Guiana dolphin (<i>Sotalia guianensis</i>) which has been shown to possess an electroreceptive system that uses the vibrissal crypts on their rostrum to detect electrical stimuli similar to those generated by small to medium sized fish (Czech-Damal <i>et al.</i>, 2012). However, this species has not been found within the Bowdun Marine Mammal Study Area and no other marine mammal has shown responses to EMF.</p> <p>Furthermore, magnetic fields from Alternating Current (AC) cables are only detectible within a few metres of the cable and decrease with distance from the cable (Hutchison <i>et al.</i>, 2020), so the lack of sensitivity combined with no exposed cables within the water column and extremely small scale of emissions means there will be no likely effect on marine mammals. As such, this impact has been scoped out of further consideration within the marine mammal EIA chapter.</p> <p>However, it should be noted that indirect effects of EMF from subsea cables on marine mammals are included within the assessment of effects on marine mammals due to altered prey availability (see Table 10.19 and Section 10.10).</p>

* Proposed Development Phase refers to construction (C), O&M (O) and decommissioning (D).

10.8 Methodology for Assessment of Effects

Overview

10.8.1 The marine mammal assessment of effects has followed the methodology set out in Volume 1, Chapter 6: Environmental Impact Assessment Methodology. Specific to the marine mammal assessment, the following guidance documents have also been considered:

- Guidance for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2024);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd, 2012);

- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency (EPA, 2022);
- Good Practice Guide for Underwater Noise Measurement (National Physical Laboratory (NPL), 2014);
- JNCC Guidelines for Minimising the Risk of Injury to Marine Mammals from UXO Clearance in the Marine Environment (JNCC, 2025a);
- Marine environment: unexploded ordnance clearance joint position statement (UK Government, 2025);
- Scaling laws for unmitigated pile driving: Dependence of underwater noise on strike energy, pile diameter, ram weight, and water depth (von Pein *et al.*, 2022);
- Marine mammal sound exposure criteria (Southall *et al.*, 2019);
- The protection of Marine EPS from injury and disturbance. Guidance for Scottish Inshore Waters (Marine Scotland, 2020);
- Guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2025b);
- Guidance on the Offence of Harassment at Seal Haul-out Site (Marine Scotland, 2019);
- Guidelines for minimising the risk of injury to marine mammals from piling sound (JNCC, 2024); and
- Guidance on Environmental Considerations for OWF Development (OSPAR Commission, 2008).

10.8.2 In addition, the marine mammal assessment of effects has considered the legislative and policy framework as set out in Volume 1, Chapter 2: Policy and Legislation.

Criteria for Assessment

10.8.3 When determining the significance of effects, a process is used which involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 4: Environmental Impact Assessment Methodology.

10.8.4 The criteria for defining magnitude in this chapter are outlined in Table 10.21. Each assessment considered the spatial extent, duration, frequency, probability and consequence of impact when determining magnitude which are outlined within the magnitude section of each impact assessment (e.g. a duration of hours or days would be considered for most receptors to be of short-term duration, which is likely to result in a low magnitude of impact).

Table 10.21: Definition of Terms Relating to Magnitude of Impact

Magnitude of Impact	Definition
<p>High</p>	<ul style="list-style-type: none"> • Extent: The impact is anticipated to occur over a large scale or geographical extent (in term of area or proportion of the reference population). • Duration: The effect is anticipated to be long-term (i.e. >15 years). • Frequency: The impact will occur repeatedly, or constantly throughout the relevant project phase, and/or at high intensity. • Probability: The impact is expected to occur. • Consequence (Adverse): The impact could result in an effect of sufficient severity to affect the FCS and/or the long-term viability of the population trajectory at a generational scale. • Consequence (Beneficial): Long-term benefits to individuals within a population (e.g. long-term improvement of key habitats) such that there is an increase to the relevant population trajectory at a generational scale.
<p>Medium</p>	<ul style="list-style-type: none"> • Extent: The impact is anticipated to occur over a medium scale or geographical extent (in terms of area, or proportion of the reference population). • Duration: The effect is anticipated to occur over a medium-term duration (i.e. seven to 15 years). • Frequency: The impact is anticipated to occur repeatedly or continuously for a moderate length of time within a relevant project phase, and/or at moderate intensity, or occurring intermittently for short periods of time, but at a moderate to high intensity. • Probability: The impact is reasonably expected to occur. • Consequence (Adverse): Impacts could result in temporary changes to behaviour and/or distribution of individuals at a scale that could result in potential reductions to lifetime reproductive success, although not enough to affect the population trajectory over a generational scale. Potential permanent effects on individuals may influence individual survival, but not at a level that would alter population trajectory over a generational scale. • Consequence (Beneficial): Impacts leading to improved habitat supporting improved foraging efficiency resulting in lifetime benefits to some individuals.
<p>Low</p>	<ul style="list-style-type: none"> • Extent: The impact is anticipated to occur over a limited scale or localised geographical extent (in terms of area or proportion of the reference population). • Duration: The effect is anticipated to be temporary (i.e., lasting less than one year) to short-term (i.e. one to seven years). • Frequency: The impact is anticipated to occur at low frequency (occurring occasionally/intermittently) for short periods of time at low intensity. • Probability: The impact is unlikely to occur. • Consequence (Adverse): Short-term and/or temporary behavioural effects in a small proportion of the reference population. Whilst there may be effects at an individual level, these would not be at a scale that would lead to any measurable population-level effects above natural variation. • Consequence (Beneficial): Minor benefit, or positive addition to individuals over a localised scale.

Magnitude of Impact	Definition
Negligible	<ul style="list-style-type: none"> • Extent: The impact is anticipated to occur over a highly localised scale or geographical extent (in terms of area or proportion of the reference population). • Duration: The impact is anticipated to be momentary (seconds to minutes) to brief (lasting less than one day). • Frequency: The impact will occur once or infrequently throughout a relevant project phase. • Probability: The effect is highly unlikely to occur. • Consequence (Adverse): Very short-term, recoverable impact on the behaviour and/or distribution in a very small proportion of the population. No potential for the any negative changes in the individual reproductive success or survival therefore no changes to the population size or trajectory. • Consequence (Beneficial): Very minor benefit to the habitat influencing foraging efficiency of a limited number of individuals.

10.8.5 The criteria for defining sensitivity in this chapter are outlined in Table 10.22. The sensitivity of marine mammal IEFs has been defined by an assessment of the ability of a receptor to adapt to a given impact from the Proposed Development (resilience and adaptability), and its ability to recover back to pre-impact conditions (recoverability).

- Adaptability is the ability of an individual to adapt its behaviour to sustain ecological functioning and allow survival.
- Resilience is the ability to withstand a perturbation by resisting change.
- Recoverability is the ability of the same species to return to a state close to that which existed before the activity or event which caused damage. Recoverability is dependent on the ability of the individuals to recover following cessation of the activity that causes the impact and is defined as the susceptibility of a species to disturbance, damage or death, from a specific external factor.

10.8.6 Information on these aspects of sensitivity of the marine mammal IEFs to given impacts has been informed by the best available robust evidence from scientific research and published literature on marine mammals (studies on captive animals as well as observations from field studies)(see Table 10.13). Evidence from field studies of marine mammals during the construction and operation of OWFs (and analogous activities such as oil and gas surveys) has been used to inform this assessment. The review of resilience, recoverability and adaptability of marine mammal IEFs has been combined to provide an overall evaluation of the sensitivity of a receptor to an impact as outlined in Table 10.22.

Table 10.22: Definition of Terms Relating to the Sensitivity of the Receptor

Sensitivity of the Receptor	Definition
High	<ul style="list-style-type: none"> • Adaptability: No ability to avoid or adapt behaviour so that individual survival and reproduction rates are affected. • Resilience: No tolerance – Effect will cause a change in both individual reproduction and survival rates. • Recoverability: No ability for the receptor to recover from any impact on vital rates (reproduction and survival rates). • Consequence: A receptor is of high sensitivity where adverse effects on multiple key ecological functions (e.g. feeding, breeding, nursing) could occur with limited tolerance and limited potential for recovery such that reproduction and survival of individuals would be affected.
Medium	<ul style="list-style-type: none"> • Adaptability: Limited ability to avoid or adapt behaviour so that individual survival and reproduction rates may be affected. • Resilience: Limited tolerance – Effect may cause a change in both individual reproduction and survival of individuals. • Recoverability: Limited ability for the receptor to recover from any impact on vital rates (reproduction and survival rates). • Consequence: A receptor is of medium sensitivity where adverse effects on one or more key ecological functions (e.g. feeding, breeding, nursing) could be sustained beyond the duration of the impact (some tolerance to the effect) but not at a level that would affect individual survival although reproductive success may be affected until the individual had recovered.
Low	<ul style="list-style-type: none"> • Adaptability: Ability to avoid or adapt behaviour so that individual reproduction rates may be affected but survival rates not likely to be affected. • Resilience: Some tolerance – Effect unlikely to cause a change in both individual reproduction and survival rates. • Recoverability: Ability for the receptor to recover from any impact on vital rates (reproduction and survival rates). • Consequence: Low sensitivity is such that adverse effects on ecological functions (e.g. feeding, breeding, nursing) are likely to be very short-term and would not affect reproductive success or individual survival.
Negligible	<ul style="list-style-type: none"> • Adaptability: Receptor is able to avoid or adapt behaviour so that individual survival and reproduction rates are not affected. • Resilience: Receptor is able to tolerate the effect without any impact on individual reproduction and survival rates. • Recoverability: Receptor is able to return to previous behavioural states/activities once the impact has ceased. • Consequence: Very little or no effect on the ecological functioning of individuals.

- 10.8.7 The magnitude of the impact and the sensitivity of the receptor are combined when determining the significance of the effect upon marine mammals. The particular method employed for this assessment is presented in Table 10.23, with the definition of significance detailed in Table 10.24.
- 10.8.8 Where a range is suggested for the significance of effect, for example, minor to moderate, it is possible that this may span the significance threshold. The technical specialist’s professional judgement will be applied to determine which outcome defines the most likely effect, which takes in to account the sensitivity of the receptor and the magnitude of impact. Where professional judgement is applied to quantify final significance from a range, the assessment will set out the factors that result in the final assessment of significance. These factors may include the likelihood that an effect will occur, data certainty and relevant information about the wider environmental context.
- 10.8.9 The EIA Regulations require the identification and reporting of significant environmental effects. For the purposes of this assessment:
- a level of moderate or more will be considered a ‘significant’ effect in terms of the EIA Regulations; and
 - a level of minor or less will be considered ‘not significant’ in terms of the EIA Regulations.

Table 10.23: Matrix Used for the Assessment of the Significance of the Effect

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major

- 10.8.10 In all cases, the evaluation of the sensitivity of the receptor, magnitude of impact and significance of effect has been informed by professional judgement and is underpinned by a narrative to explain the conclusions reached.

Table 10.24: Definition of Significance

Impact	Justification
Negligible	No effects or those that are beneath levels of perception, within normal bounds of variation, or within the margin of forecasting error.
Minor	These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the Proposed Development.
Moderate	These beneficial or adverse effects have the potential to be important and may influence the decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular resource or receptor.
Major	These beneficial or adverse effects are very important and are likely to be material in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national, or regional importance. However, a major change in a site or feature of local importance may also enter this category.

Approach for Subsea Noise Assessment

- 10.8.11 Marine mammals, in particular cetaceans, are dependent on sound for many aspects of their life, including prey identification, predator avoidance, communication and navigation (Au *et al.*, 1974; Bailey *et al.*, 2010). There is therefore the potential for noise emissions from all phases of the Proposed Development to adversely affect marine mammals. Subsea noise has the potential to affect marine life in different ways depending on the sound level and characteristics, and distance from source. These effects range from physical trauma at very close range to high intensity noise (e.g. underwater explosions), to hearing impairment, and behavioural reactions. Beyond these impact ranges, masking can also occur.
- 10.8.12 The subsea noise technical report (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report) uses peer reviewed models to calculate the impact ranges for marine mammals at each phase of the development (pre-construction, construction, O&M and decommissioning (see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for full detail on the modelling approach). Key modelled sources include:
- clearance of UXO;
 - geophysical and geotechnical surveys;
 - impact piling;
 - vessels; and
 - operational Wind Turbines.

Injury

- 10.8.13 Exposure to very high intensity sounds at close ranges could result in physical trauma or, in extreme cases, death (e.g. underwater explosions). However, exposure to less intense sounds can result in injury to marine mammals' hearing. Auditory injury is considered to have occurred when there is a permanent change to the individual's hearing sensitivity (known as a Permanent Threshold Shift (PTS)). Hearing impairment can occur where there is a temporary reduction in hearing sensitivity (known as a Temporary Threshold Shift (TTS)). TTS is considered to be impairment rather than injury because an animal's auditory system can recover.
- 10.8.14 Auditory injury criteria are used to assess potential impacts to marine mammals. The threshold criteria as published in Southall *et al.* (2019) has been used as industry standard. However, recently updated guidance has been published by the National Marine Fisheries Service (NMFS, 2024). NMFS (2024) has compiled, interpreted and synthesised the scientific literature to produce criteria for the onset of TTS and auditory injury (AUD INJ), which includes (but is not limited to) PTS. This updated guidance is considered to reflect the current state of knowledge regarding the characteristics of sound exposure that has the potential to affect marine mammal hearing sensitivity.
- 10.8.15 The Volume 3, Appendix 10.4: Subsea Noise Technical Report has modelled the risk of injury to marine mammals using both Southall *et al.* (2019) and NMFS (2024) criteria. In this chapter the results using NMFS (2024) are presented as these represent the latest scientific understanding. Please see the Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for more detail and comparison of both sets of threshold criteria. TTS threshold information is presented in the chapter primarily for context but is used specifically for the assessment of potential disturbance impacts arising from UXO clearance activities (Section 10.10) as advised in the Scoping Opinion (MD-LOT, 2024a).
- 10.8.16 The dual metric approach is applied as per the latest guidance (NMFS, 2024). This approach includes evaluating both the unweighted peak Sound Pressure Levels (SPL) and the hearing weighted cumulative Sound Exposure Level (SEL_{cum}), with the use of whichever of the two metrics which results in the larger isopleth for the assessment of onset AUD INJ. Marine mammal species are grouped into FHG based on generalised hearing ranges for the species group as a whole (Table 10.25). Weighting functions are defined using the frequency characteristics (bandwidth and sound level) for each hearing group within which acoustic signals can be perceived, and therefore, assumed to have potential auditory effects. The weighting functions used in noise modelling act as filters, to de-prioritise frequency content that is less relevant for the species hearing group.

Table 10.25: Marine Mammal Hearing Groups with their Generalised Hearing Ranges (NMFS, 2024)

Hearing Group	Example Species	Generalised Hearing Range
Low Frequency cetaceans (LF)	Minke whale	7 Hz to 36 kHz
HF cetaceans	Delphinids (e.g. bottlenose dolphin, white-beaked dolphin)	150 Hz to 160 kHz
Very High Frequency cetaceans (VHF)	True porpoises (e.g. harbour porpoise)	200 Hz to 165 kHz
Phocid pinnipeds (PW)	True seals (e.g. harbour seal and grey seal)	40 Hz to 90 kHz

10.8.17 It is worth noting that the hearing group nomenclature has varied slightly over the development of the threshold criteria guidance. NMFS (2024) refer to ‘phocid pinnipeds’ (underwater) as PW, whereas Southall *et al.* (2019) call this group ‘Phocid carnivores in water’ (PCW). Aside from the differences in nomenclature, the hearing groups are effectively the same and are henceforth referred to as PCW.

10.8.18 Further, sound level metrics can be described using different terminology depending on the source reference. A summary of relevant acoustic terminology is provided in Table 10.30 below. This chapter follows the terminology used in the Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report and uses Southall *et al.* (2019) terminology (i.e. uses PCW and OCW for the pinniped hearing groups). The TTS and auditory injury thresholds used for this assessment are summarised in Table 10.27.

Table 10.26: Summary of Acoustic Terminology

Metric	NMFS (2024)	Southall <i>et al.</i> (2019)	ISO (2017)	Reference Value
Peak Sound Pressure Level	$L_{p, 0-p; flat}$	Peak SPL (unweighted)	$L_{p, pk}$	dB re 1 μ Pa
Sound Exposure Level (LF)	$L_{E, p, LF, 24h}$	SEL (LF weighted)	L_E	dB re 1 μ Pa ² s
Sound Exposure Level (HF)	$L_{E, p, HF, 24h}$	SEL (HF weighted)	L_E	dB re 1 μ Pa ² s
Sound Exposure Level (VHF)	$L_{E, p, VHF, 24h}$	SEL (VHF weighted)	L_E	dB re 1 μ Pa ² s
Sound Exposure Level (PCW)	$L_{E, p, PW, 24h}$	SEL (PCW weighted)	L_E	dB re 1 μ Pa ² s

Table 10.27: Summary of TTS and Auditory Injury Acoustic Thresholds (NMFS, 2024)

Hearing Group	Parameter	Impulsive		Non-Impulsive	
		TTS	AUD INJ	TTS	AUD INJ
LF cetaceans	Peak SPL, unweighted	216	222	-	-
	SEL, LF weighted	168	183	177	197
HF cetaceans	Peak SPL, unweighted	224	230	-	-
	SEL, HF weighted	178	193	181	201
VHF cetaceans	Peak SPL, unweighted	196	202	-	-
	SEL, VHF weighted	144	159	160	181

Hearing Group	Parameter	Impulsive		Non-Impulsive	
		TTS	AUD INJ	TTS	AUD INJ
PCW	Peak SPL, unweighted	217	223	-	-
	SEL, PCW weighted	168	183	175	195

10.8.19 The dual metric approach means that as well as calculating the unweighted peak sound level at various distances, it is also necessary to calculate the received levels of noise in terms of the accumulated exposure over time (SEL weighted). Simplified modelling assumes that the animal is static at a fixed distance from the noise source. This, however, would give a highly unrealistic level of exposure as animals are highly unlikely to remain stationary when exposed to loud noise. The assumption is that the animals move directly away from the sound. The exposure assessment has made a simplistic assumption that an animal would be exposed over the duration of the piling activity and that there would be no breaks in activity during this time. It was assumed that an animal would swim away from the sound source at the onset of activity at a constant rate and subsequently, conservative species-specific swim speeds were incorporated into the model, summarised in Table 10.28.

Table 10.28: Assessment Swim Speeds of Marine Mammals that are Likely to Occur Within the North Sea for the Purposes of Exposure Modelling

Species	Hearing group	Swim speed (m/s)	Source reference
Harbour porpoise	VHF	1.5	Otani <i>et al.</i> (2000)
Bottlenose dolphin	HF	1.52	Bailey <i>et al.</i> (2010)
White-beaked dolphin	HF	1.52	Bailey <i>et al.</i> (2010)
Minke whale	LF	2.3	Boisseau <i>et al.</i> (2021)
Grey seal	PCW	1.8	Thompson <i>et al.</i> (2015)
Harbour seal	PCW	1.8	Thompson <i>et al.</i> (2015)

Disturbance

10.8.20 Beyond the zone of injury, sound levels are such that auditory or physical injury is less likely to occur but could be sufficient to elicit a behavioural response. A marine mammal's response to disturbance will depend on the individual and the context. Previous experience and motivation will affect whether an individual exhibits an aversive response to sound, particularly in an area with high sound levels related to human activities (National Research Council, 2003).

10.8.21 Non-trivial disturbance, which is defined as disturbance to the marine EPS which is *“likely to at least increase the risk of a certain negative impact on the species at FCS”* (JNCC, Natural England and Countryside Council for Wales, 2010), may occur when there is a risk of animals incurring sustained or chronic disruption of behaviour. The determination of the likelihood and extent of disturbance is difficult. There are no agreed-upon disturbance criteria, primarily

because there are no clear threshold criteria that can be used due to the variability of documented animal responses to similar levels of noise.

10.8.22 Therefore, this assessment has applied several disturbance thresholds considered to be most appropriate relative to the noise generating activities assessed for the Proposed Development (Table 10.29). When referring to mild disturbance this refers to trivial disturbance, which is defined as “*Sporadic disturbances without any likely negative impact on the animals...such as that resulting in short term behavioural reactions*” whereas strong disturbance refers to non-trivial disturbance (JNCC, Natural England and Countryside Council for Wales, 2010). See the Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for more detail.

Table 10.29: Summary of Disturbance Criteria Used in the Assessment

Effect	Non-impulsive Threshold (SPL _{rms})	Impulsive Threshold (Other Than UXO) (SPL _{rms})	UXO Clearance	Impulsive Threshold (piling)
Mild disturbance (all marine mammals)	-	140 dB re 1µPa	-	Dose-Response
Strong disturbance (all marine mammals)	120 dB re 1µPa	160 dB re 1µPa	TTS onset	

10.8.23 The disturbance assessment for continuous (non-impulsive) sound (e.g. vessel activity) has used the NMFS’ (2005; 2025) guidance Level B harassment threshold (analogous to disturbance) for continuous sound at 120 dB re 1 µPa (rms). Level B harassment is defined by NMFS (2005) as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2010) description of non-trivial disturbance and has therefore been used as the basis for onset of behavioural change in the assessment. Considering the high level variation of data, due to the variable nature of individual animal behaviour (Southall *et al.*, 2021), relating to the onset of behavioural effects due to continuous sound, any ranges predicted using this number are likely to be probabilistic and potentially over precautionary.

10.8.24 For impulsive sound sources (other than piling and UXO clearance, such as UHRS) this assessment has adopted the NMFS (2005) Level B harassment threshold of 160 dB re 1 µPa (rms) for impulsive sound.

10.8.25 The UXO clearance assessment has used the TTS threshold as a proxy for disturbance (NMFS, 2024). The TTS threshold is used to assess behavioural response where one detonation occurs per day, and the behavioural threshold (-5 dB from TTS onset) is taken for multiple detonations within a 24-hour period.

- 10.8.26 NMFS (2005) guidance is based on thresholds above which strong or mild disturbance could occur and has been widely applied to piling assessments within UK OWF assessments. However, there have been further studies using empirical evidence from data gathered in the field during impact piling activity, which demonstrate a proportional disturbance response of animals corresponding to decreasing levels of received sound moving further away from the source. The risk of disturbance from impact piling has been assessed using a dose-response approach, as supported in the Scoping Opinion (MD-LOT, 2024a), with further detail on this approach taken as detailed below.

Dose-response (D/R)

- 10.8.27 The application of a D/R function allows for a more realistic assessment of the risk of disturbance as this takes into account the likelihood of a response, in comparison to a fixed noise threshold, as this assumes all individuals within the fixed noise threshold respond, whereas outside the contour there is no response.
- 10.8.28 Southall et al. (2019) stated that “Apparent patterns in response as a function of received noise level (sound pressure level) highlighted a number of potential errors in using all or nothing ‘thresholds’ to predict whether animals will respond. Tyack and Thomas (2019) subsequently and substantially expanded upon these observations. The clearly evident variability in response is likely attributable to a host of contextual factors, which emphasises the importance of estimating not only a dose-response function but also characterising response variability at any dosage”.

Approach for Cetacean Species

- 10.8.29 Current D/R functions used for assessment regarding cetacean disturbance are based on Graham *et al.* (2017) (Figure 10.4) and were developed using monitoring data obtained in the Moray Firth as part of the Beatrice OWF monitoring programme. Graham *et al.* (2019) presented updated information (Figure 10.5) gathered from further monitoring of piling in the Moray Firth. Analysis of the Passive Acoustic Monitoring (PAM) data showed a 50% probability of response to piling within 7.4 km for the first location piled, which reduced to within 1.3 km by the final piling location, suggesting that the use of the D/R functions from 2017 is precautionary.
- 10.8.30 In the absence of species-specific data for other cetacean species, the same D/R curve was assumed to apply to all cetacean species in this assessment and represents a precautionary approach to assessment as other cetacean species are likely to be less sensitive than harbour porpoise to behavioural disturbance as noted in the literature (Tougaard, 2021)

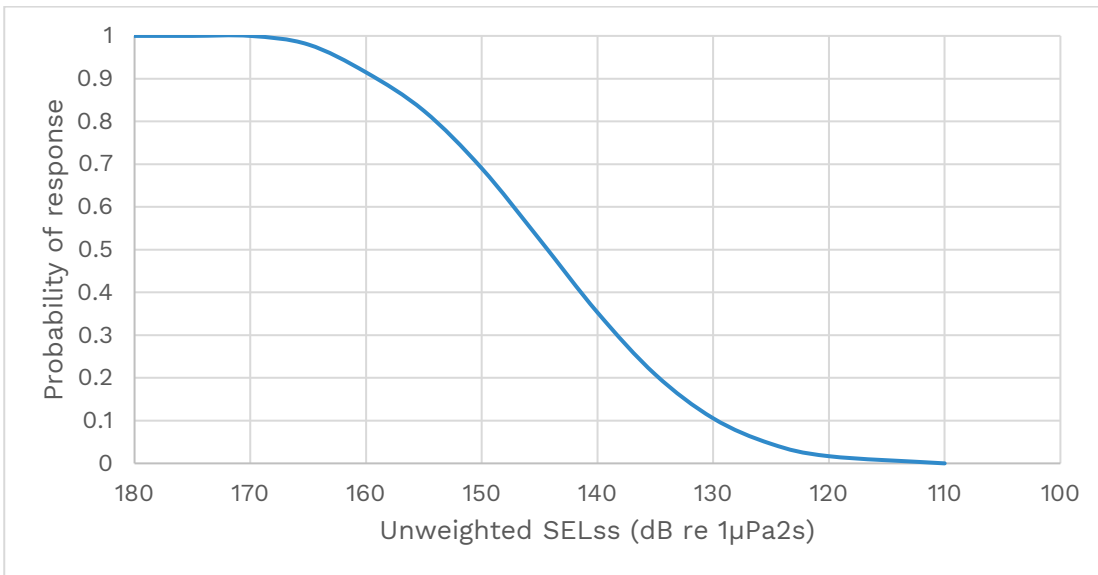


Figure 10.4: Relationship Between the Proportion of Harbour Porpoise Responding and the Received Single Strike SEL (SELs) Graham *et al.* (2017)

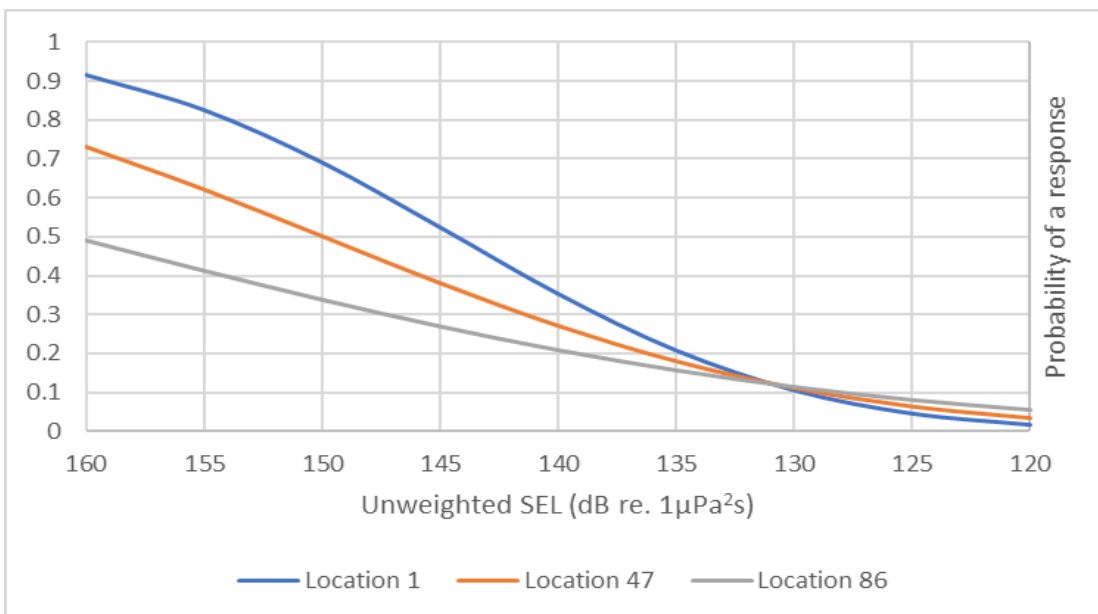


Figure 10.5: The Probability of a Harbour Porpoise Response (24 Hr) in Relation to the Unweighted Received Single-Pulse SEL for the First Location Piled (Blue Line), the Middle Location (Orange Line) and the Final Location Piled (Grey Line). Reproduced From Graham *et al.* (2019)

10.8.31 The recent PrePARED paper (Thompson *et al.*, 2025) highlights the over-precaution relating to the use of the Graham *et al.* (2017) dose-response functions. One issue is that received levels of noise may not be the key driver of disturbance. Further, that the use of an unweighted metric may overestimate noise levels for harbour porpoises, because noise propagation with distance alters the frequency content due to quick attenuation of HF sound. This means for porpoise, a VHF cetacean, that the impact piling noise may not be audible at the further ranges covered by the D/R noise contours.

- 10.8.32 The case study presented in Thompson *et al.* (2025) stated that the monitoring data indicated that around 150 porpoises would have been at risk of disturbance by each piling event. When compared to the maximum design prediction (using the Graham *et al.* (2017) D/R functions) of 4,681 porpoises, the prediction is approximately 31 times more than the number estimated from monitoring information.
- 10.8.33 Current D/R functions detail a probability of response down to a noise contour of 120 dB SEL_{ss} and the noise modelling provided for this Proposed Development indicate that this contour will extend to a range of ~395 km. Thompson *et al.* (2025) highlights that the potential for significant disturbance to occur in the far field “*are biologically implausible*”.
- 10.8.34 The emerging evidence strongly suggests that the use of the Graham *et al.* (2017) is highly over precautionary. In the absence of any alternative approach, the Graham *et al.* (2017) D/R functions have been applied, but the assessment has been capped at the 140 dB SEL_{ss} contour to derive an estimate of the number of animals at risk of disturbance. The following was considered in order to define this approach:
- Graham *et al.* (2017) considered that harbour porpoise responded to piling when the proportional decrease in occurrence exceeded the threshold of 0.5, therefore, anything below a 50% chance was not considered to be a significant behavioural response.
 - Graham *et al.* (2019) found that there was a greater than or equal to a 50% chance of porpoises responding in the 24-hour period after piling to an unweighted SEL of 144.3 dB re 1 mPa² s (95% Confidence Interval (CI) 142.1–146.8) at the first location piled.
 - Fixed threshold disturbance examples include the NMFS (2005) Level B harassment, which is considered to represent a non-trivial disturbance of 160 dB_{rms}. SEL and SPL route mean square (rms) are different metrics, and direct comparison should be treated with caution, but as a generality SEL_{ss} is approximately 5 dB greater numerically than SPL_{rms} (Seiche, pers comm). Therefore 160 dB_{rms} could be considered relative to the 150 dB – 155 dB contour.
 - Other fixed thresholds that have been used for impact piling assessment include 143 dB SEL_{ss} (Tougaard, 2021); 145 dB SEL_{ss} (Lucke *et al.*, 2009); or 140 dB SEL_{ss} (ASCOBANS, 2014).
 - Whilst fixed thresholds represent an all or nothing response areas and are therefore not necessarily equivalent to a D/R approach, the examples above are detailed for context as to noise levels considered to elicit a behavioural response.
- 10.8.35 The D/R functions described in Graham *et al.* (2017) indicate that there is less than a 20% probability of a response at noise levels below 140 dB SEL_{ss}. A 20% probability is not considered to be a significant behavioural response, together with the emerging data published in Thompson *et al.* (2025) suggests therefore that capping the Graham *et al.* (2017) D/R curves at the 140 dB SEL_{ss} contour

will capture those individuals most at risk of non-trivial disturbance, whilst retaining sufficient precaution.

Approach for Seal Species

10.8.36 Whyte *et al.* (2020) used tracking data from 24 harbour seal to estimate the effects of pile driving sounds on this species. The study used predictions of seal density during pile driving made by Russell *et al.* (2016). Predicted seal density significantly decreased within 25 km or above 145 dB re 1 μPa^2 SEL_{ss} (averaged across depths and pile installations). Other studies have reported similar avoidance reactions for both grey seal and harbour seal to the same sound source (Aarts *et al.*, 2018; Götz and Janik, 2010) and therefore harbour seal dose-response curve is considered as appropriate to be used as a proxy for grey seal. As such, the D/R curve derived from Whyte *et al.* (2020) (Figure 10.6) was applied to the grey seal assessment to determine the number of animals that may potentially respond behaviourally to received sound levels during piling.

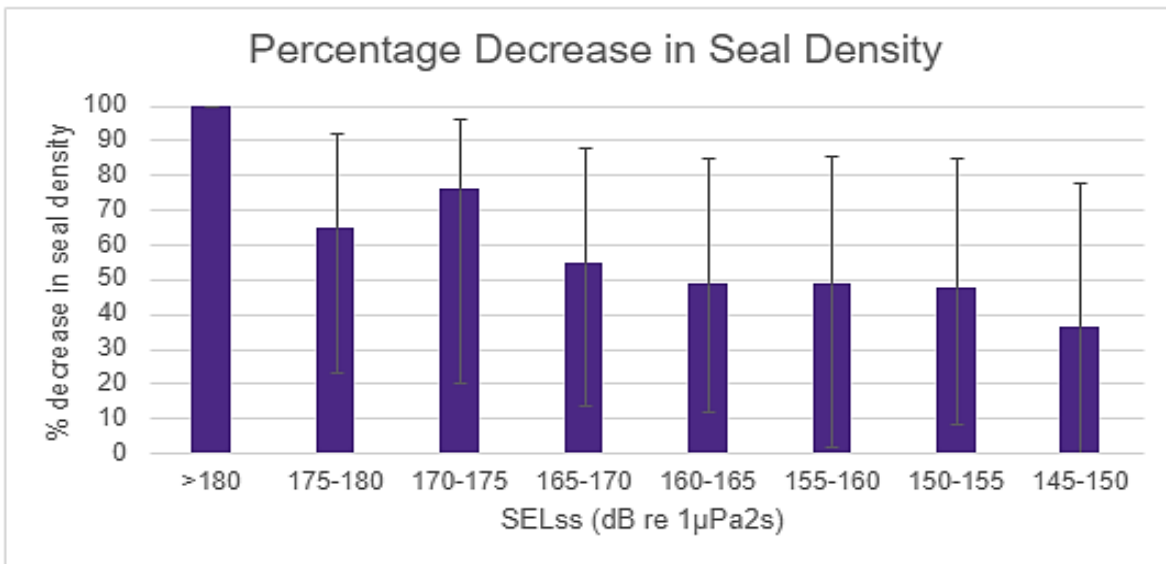


Figure 10.6: Predicted Decrease in Seal Density as a Function of Estimated Sound Exposure Level, Error Bars Show 95% CI (from Whyte *et al.*, 2020)

Approach for Marine mammals

10.8.37 To obtain the numbers of animals (cetaceans and seals) disturbed during piling, SEL_{ss} contours from subsea noise modelling were plotted by 5 dB contours in Geographical Information System (GIS) for all modelled locations. The areas within each contour were calculated from the spatial GIS map and a proportional expected response (derived from the dose-response curve for each contour area) was used to calculate the number of animals potentially disturbed. These numbers were subsequently summed across all contours to estimate the total number of animals disturbed during piling at any given time. The number of animals predicted to respond are based on species-specific densities derived from site-specific surveys and desktop data.

Assumptions and Limitations

- 10.8.38 By applying the fixed threshold based and D/R criteria, the magnitude of impact can be quantified with respect to the spatial extent of disturbance, and subsequently the number of animals potentially disturbed based on available density information. However, Southall *et al.* (2021) noted that it is challenging to develop a comprehensive set of empirically derived criteria for such a diverse group of animals. The study identified data gaps, as for example, measurements of the effects of elevated sound on mysticetes have never been conducted and extrapolation from other species has been necessary. Since there are broad differences in hearing across the frequency spectrum for different marine mammal hearing groups, sounds that disturb one species may be irrelevant or inaudible to other species. Variance in responses even across individuals of the same species are well documented to be context and sound-type specific (Ellison *et al.*, 2012). In addition, the potential interacting and additive effects of multiple stressors (e.g. reduction in prey, sound and disturbance, contamination, etc.) is likely to influence the severity of responses (Lacy *et al.*, 2017).
- 10.8.39 Marine mammal ability to compensate for chronic exposure to sound will also depend on a range of ecological factors, including the relative importance of the disturbed area and prey availability within their wider home range, the distance to and quality of other suitable sites, the relative risk of predation or competition in other areas, individual exposure history, and the presence of concurrent disturbances in other areas of their range (Gill *et al.*, 2001). Animals may be able to compensate for short-term disturbances by feeding in other areas, for example, which would reduce the likelihood of longer-term population consequences. Booth (2019) reported that although minimising the anthropogenic disturbance is an important factor to animal's health, if animals can find suitable high-energy-density prey they may be capable of recovering from some lost foraging opportunities. Christiansen and Lusseau (2015) studied the effect of whale-watching on minke whale in Faxafloi Bay, Iceland and found no significant long-term effects on vital rates, although years with low sandeel density led to increased exposure to whale-watching as whales were forced to move into disturbed areas to forage. Odontocetes may be more vulnerable to whale-watching compared to mysticetes due to their more localised, and often, coastal home ranges. Bejder *et al.* (2006) documented a decrease in local abundance of bottlenose dolphin which was associated with an increase in whale-watching in a tourist area compared to a control area. Studies of changes in abundance as a result of disturbance should be considered in light of findings presented in Gill *et al.*, (2001) who reported that if there is no suitable habitat nearby animals may be forced to remain in an area despite the disturbance, regardless of whether or not it could affect survival or reproductive success.
- 10.8.40 The marine mammal receptors considered in this assessment vary biologically and therefore have different ecological requirements that may affect their sensitivity to disturbance. This point is illustrated by the differences between marine mammals identified as key biological receptors in the baseline. Humpback whale and grey seal are capital breeders and store energy for reproduction and survival, whilst harbour porpoise (and other cetaceans whose

ecology is well studied, e.g. bottlenose dolphin) are income breeders and they use energy that is acquired on a continual basis, including during the reproductive period (Stephens *et al.*, 2009).

10.8.41 Recognising the inherent uncertainty in the quantification of effects using threshold and D/R approaches, this assessment has adopted a precautionary approach at all stages of assessment, including additional conservative assumptions in the:

- marine mammal baseline (e.g. the use of the most appropriate highest density estimates (Table 10.15));
- the MDS for all activities assessed (Table 10.19); and
- noise modelling conservatism (see below).

10.8.42 These assumptions have been referred to throughout this chapter, illustrating that the systematic incorporation of layers of conservatism is likely to result in a very precautionary assessment.

Conservatism in the Subsea Noise Modelling

10.8.43 In order to ensure that the assessment is precautionary, a number of conservative assumptions were adopted in the subsea noise model. These measures of conservatism are summarised in this section and highlight that both auditory injury (and TTS onset ranges) predicted using the SEL_{cum} threshold are likely to lead to overestimates in the ranges and therefore should be interpreted with caution. For more details, refer to Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report.

10.8.44 The subsea noise modelling assumed that the maximum hammer energy would be reached and maintained at all locations, whereas this is unlikely to be the case based on examples from other OWFs, e.g. Beatrice OWF (Beatrice OWF Limited, 2018).

10.8.45 Additionally, the piling procedure simulated in the model does not allow for short pauses in piling (e.g. for realignment) and therefore the modelled SEL_{cum} is likely to be an overestimate.

10.8.46 The subsea noise modelling assessment also assumed that animals swim directly away from the sound source at constant and conservative average speeds based on published values. Whilst this buffers the uncertainty with respect to the directionality of their movement, it may lead to overestimates of the potential range of effect as animals are likely to exceed these speeds. The subsea noise model accounts for the SEL_{cum} metric as an equal-energy rule, where exposures of equal-energy are assumed to produce the same sound-induced threshold shift regardless of how the energy is distributed over time. Since for intermittent sound (such as piling) the quiet periods between sound exposures will allow some recovery of hearing compared to continuous sound, the equal-energy rule is likely to overestimate the extent of impact. Additionally, modelling of concurrent piling assumes piling will occur at exactly the same time and strike piles simultaneously, whereas in reality, this is highly unlikely and could lead to overestimates in the injury and/or disturbance ranges.

- 10.8.47 The impulsive sound is likely to undergo transition into non-impulsive sound at distance from the sound source due to a combination of factors (e.g. dispersion of the waveform, multiple reflections from sea surface and seafloor, and molecular absorption of HF energy). The empirical evidence suggests that such shifts in impulsivity could occur within 10 km from the sound source (Hastie *et al.*, 2019). The Offshore Renewables Joint Industry Programme (ORJIP) RaDIN study (Matei *et al.*, 2024) concluded that “*there was a marked decrease in impulsiveness as sounds travel away from the source within 5 km of the piling location*” and that, “*there is still insufficient evidence to establish a range of distances from which these sounds are no longer impulsive*”.
- 10.8.48 The subsea noise model has therefore adopted the impulsive thresholds at all ranges. This assumption is likely to lead to an overly precautionary estimate of injury ranges at larger distances (tens of kilometres) from the noise source.

Designated Sites

- 10.8.49 This chapter assesses the likely significant environmental effects in EIA terms on the qualifying feature(s) of SACs for marine mammals. The RIAA for the Proposed Development includes the assessment of the potential impacts on the site itself. A summary of the outcomes reported in the RIAA is provided in the RIAA, Part 2: Special Areas of Conservation (TWP-BOW-RPS-OFE-RPT-00014).
- 10.8.50 However, assessment of the likely significant environmental effects on a local or nationally designated site which falls outside the boundaries of a European Site, but within the Regional Marine Mammal Study Area, has been undertaken. Assessment of impacts to minke whale as a Qualifying Feature of the Southern Trench ncMPA is provided in Volume 3, Technical Appendix 8.3: Marine Protected Areas Assessment.

10.9 Embedded Mitigation

- 10.9.1 As part of the Proposed Development design process, a number of Embedded Mitigation measures have been proposed to reduce the potential for impacts on marine mammals (see Table 10.30). They are considered at every stage of the Proposed Development through design and best practice and, as there is a commitment to implementing these measures, these have been considered in the assessment presented in Section 10.10 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These Embedded Mitigation are considered standard industry practice for this type of development.

Table 10.30: Embedded Mitigation Adopted as Part of the Proposed Development

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
3	Development of, and adherence to, a Piling Strategy. This will detail use of Acoustic Deterrent Devices (ADDs), slow start, soft start, and ramp up procedures, as appropriate, as well as any Additional Mitigation measures, where determined to be required, in consultation with stakeholders including NatureScot and Marine Directorate-Licensing Operations Team (MD-LOT).	<p>Implementation of initiation stage and soft start during piling. This will involve the use of a low hammer energy with a low number of strikes used initially, followed by lower hammer energies at a higher strike rate at the beginning of the piling sequence before energy input is ‘ramped up’ (increased) over time to required higher levels.</p> <p>The Piling Strategy will be submitted post-consent prepared in collaboration with stakeholders, including but not limited to, MD-LOT and NatureScot, following collation of additional data and final design parameters (e.g. piling locations, hammer energies). Noise modelling will be reviewed with the additional information and inform the final Piling Strategy, which will be submitted to MD-LOT.</p> <p>These measures will reduce the likelihood of injury from elevated subsea noise to marine mammals in the immediate vicinity of piling operations as far as practicable, allowing individuals to move away from the area before sound levels reach a level at which injury may occur. This is in line with the most up to date guidance for piling operations (JNCC, 2010) and, in most cases, compliance with this guidance reduce the likelihood of injury to marine mammal receptors to negligible levels.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the Piling Strategy.</p>
5	Development of, and adherence to, an Environmental Management Plan (EMP), including a Marine Pollution Contingency Plan (MPCP) and a Biosecurity Plan with commitments to monitoring and actions to minimise Invasive Non-Native Species (INNS).	The Outline EMP provides a means to ensure that the management of potential environmental impacts is efficient and that all commitments are clearly communicated at all stages. The Outline EMP will include an MPCP, which will include planning for accidental spills and sources of contaminant releases, and an Invasive Non-Native Species Management Plan (INNSMP), to provide measures for controlling the introduction and spread of INNS. The INNSMP is included here to address the indirect effects on marine mammals due to altered prey availability and further detail is presented within Volume 2, Chapter 9: Fish and Shellfish Ecology and Volume 2, Chapter 8: Benthic Ecology. An outline MMMP will

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
		<p>also be developed for the Proposed Development, see below for more information.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for an Outline EMP.</p>
6	<p>Development of, and adherence to, a Marine Mammal Mitigation Protocol (MMMP), to minimise the risk of auditory injury to marine mammals from noise generating activities resulting from the construction of the Proposed Development. Mitigation will include measures such as Marine Mammal Observers (MMOs), Passive Acoustic Monitoring (PAM) and Acoustic Deterrent Devices (ADDs).</p>	<p>Outline Marine Mammal Mitigation Protocol</p> <p>The development of and adherence to a MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) which will present appropriate mitigation for activities that could potentially lead to injurious effects on marine mammals (e.g. piling, UXO clearance and geophysical surveys).</p> <p>For piling, measures will include setting a mitigation zone based on the maximum predicted injury range using unweighted peak SPL metric for the maximum spatial scenario across all marine mammal species. The outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) sets out measures to be applied in advance of and during piling activity, including:</p> <ul style="list-style-type: none"> • Visual monitoring carried out by MMOs; • Acoustic monitoring by PAM Operators; and • ADDs to discourage marine mammals from approaching an area where injury may occur. <p>For UXO clearance, measures will include setting a mitigation zone of at least 1.1 km in line with current guidance (JNCC, 2025a). The extent of the mitigation zone will be informed by the subsea noise modelling, and the injury ranges Standard industry measures including visual and acoustic monitoring by PAM and MMO operatives so that animals are outside the injury zone, plus the use of an ADD to deter animals over the injury zone.</p> <p>For geophysical surveys, measures will include setting a mitigation zone of at least 500 m in line with current guidance (JNCC, 2017), with the extent of the mitigation zone informed by the largest injury range across</p>

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
		<p>all types of geophysical surveys. Mitigation during geophysical surveys will involve visual and acoustic monitoring using MMOs and PAM so that the risk of injury over the defined mitigation zone is reduced in line with JNCC guidance (JNCC, 2017).</p> <p>An outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) has been developed on the basis of the most recent published statutory guidance (JNCC, 2010; JNCC, 2023; JNCC, 2025a)</p> <p>The implementation of the finalised MMMP will mitigate for the risk of permanent auditory injury to marine mammals within a pre-defined 'mitigation zone' for each activity. The mitigation zone is determined considering the largest injury zone across all species for each relevant activity.</p> <p>The outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) includes visual and acoustic monitoring as a minimum over the defined mitigation zones so that animals are clear before the activity commences. Together with ADDs to deter animals from injury risk zones.</p> <p>In line with the most recent guidance for UXO clearance (JNCC, 2025a). Low order clearance methods are the default. If high order clearance is considered to be unavoidable, potential Additional Mitigation measures will be discussed in the outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol).</p> <p>Applicant will consult with NatureScot and MD-LOT with regards to mitigation should USVs/AUVs be used for activities associated with the Proposed Development and relevant EPS Licences will be sought.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for a finalised and agreed MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol).</p>

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
7	Development of, and adherence to, a Construction Method Statement (CMS) along with a Code of Construction Practice (CoCP).	<p>The CMS and CoCP are the overarching documents prepared to set out the construction methods, good working practices and mitigation measures.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for a CMS.</p>
8	All relevant Health and Safety Executive (HSE) procedures will be followed.	As with the CMS, construction procedures will consider all relevant health and safety risks and follow HSE legislation and guidance to mitigate these potential identified risks.
9	Development of, and adherence to, a combined Navigation Safety and Vessel Management Plan (NSVMP), describing Project vessels' requirements, passages, monitoring and controls.	<p>The Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) will include measures to reduce disturbance to marine mammal receptors from transiting vessels, requiring them to:</p> <ul style="list-style-type: none"> • not deliberately approach marine mammals as a minimum; • avoid abrupt changes in course or speed should marine; • mammals approach the vessel to bow-ride; • remain at safe speeds at all times and reduce speed if appropriate when a marine mammal is in the vicinity; and • adherence by vessels to guidelines laid out in the SMWWC. <p>The Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) will be adhered to at all times.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for an Outline NSVMP (Volume 4, Appendix 28: Outline Navigational Safety and Vessel Management Plan).</p>
24	Development of, and adherence to, a Development Specification and Layout Plan (DSLPL). The development of the DSLPL includes consultation with the relevant authorities for approval, including the Maritime and Coastguard Agency (MCA) and Northern Lighthouse Board (NLB).	Decreases the risk of collision with vessels or allision with Offshore Infrastructure and thus reduces the potential for accidental pollution to the surrounding environment, therefore reducing the risk from accidental pollution for marine mammals within the vicinity of these events.

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
34	Drafting and implementation of a decommissioning programme, prepared in accordance with requirements of the Energy Act 2004, which will set out the extent of infrastructure to be removed as well as the methods and processes which will be used.	<p>A decommissioning plan will be agreed and implemented at the end of the operational lifetime of the Proposed Development. Within the plan, industry standard mitigation measures using the latest statutory guidance (e.g., JNCC, 2010; JNCC, 2023; JNCC, 2025a) will be employed to mitigate any potential injury risk to marine mammals.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for a decommissioning plan.</p>
36	Where practicable, the use of low order disposal of UXOs will be implemented (i.e. deflagration).	<p>Low order UXO clearance techniques generate less subsea noise than high order detonation and therefore present a lower risk of injury to sound-sensitive receptors such as marine mammals during UXO clearance. Noting the position statement from statutory authorities on UXO clearance (UK Government, 2025) the option to clear UXOs with low order techniques has been considered as the default method for the Proposed Development.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for an Outline EMP.</p>
37	Adoption of Joint Nature Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from geophysical surveys, piling noise and use of explosives if and where required.	<p>An outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) has been developed on the basis of the most recent published statutory guidance (JNCC, 2010; JNCC, 2023; JNCC, 2025a).</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for a finalised and agreed MMMP.</p>
40	Creation of a Waste Management Plan (WMP), which will describe the processes for handling and managing any waste materials.	<p>The WMP will set out procedures to ensure all waste processing and handling activities with the potential to affect the environment are appropriately managed.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the requirement for an Outline EMP.</p>
53	Low order clearance techniques are the default method for UXO clearance (Mitigation measure 36) and would not require Additional Mitigation over and above the Embedded Mitigation measures	<p>Mitigation measure 36 details that low order clearance is the default method for the Proposed Development, consistent with the guidance set out in the SNCB joint position statement on UXO clearance (UK Government, 2025). Low noise alternatives to high order detonation are</p>

Mitigation ID Number*	Embedded Mitigation Measures Adopted as Part of the Proposed Development	Justification
	<p>within the outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). However, should high order clearance be unavoidable Additional Mitigation may be required dependant on the results of the UXO Risk Assessment. Appropriate mitigation measures will be discussed and agreed with MD-LOT and NatureScot with the detail to be agreed for the finalised MMMP.</p>	<p>commercially available and cause less environmental harm. In line with this guidance high order clearance methods as a contingency will be considered once the results of the UXO geophysical survey are available. Should high order clearance be considered necessary, mitigation measures proportionate to the identified risk will be implemented for the Proposed Development in order to mitigate the impacts to marine mammals.</p> <p>Secured in the Section 36 Consent and Marine Licences, via the requirement for a finalised and agreed MMMP.</p>
54	<p>Development of, and adherence to, a Project Environmental Monitoring Plan (PEMP) to include details of any agreed surveys or monitoring requirements.</p> <p>The PEMP will provide the mechanism to validate the impact assessment, assess the effectiveness of mitigation measures, and inform adaptation of mitigation measures throughout the construction phase of the Proposed Development.</p>	<p>The PEMP will detail the methodology that will be used validate the impact assessment predictions made within the EIA. Subsea noise levels will be measured and monitored during the construction phase (impact piling operation). The PEMP will also provide for the mechanism for any adaptation of marine mammal mitigation measures if required to reduce impacts from the Proposed Development.</p> <p>Secured in the Section 36 Consent and Marine Licences, via the requirement for a PEMP.</p>

*see Volume 3, Technical Appendix 4.6: Schedule of Mitigation and Commitments

10.10 Assessment of Significance

10.10.1 Table 10.19 (Section 10.7) summarises the potential effects arising from the construction, O&M and decommissioning phases of the Proposed Development on marine mammals, as well as the MDS against which each impact has been assessed. An assessment of the likely significant effects of the Proposed Development on the marine mammal receptors caused by each identified impact is provided within this section.

IMPACT 1: INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING PILING

Summary of Piling Scenarios

10.10.2 A summary of the piling scenarios modelled is presented in this section. Please see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for more details.

10.10.3 The impact piling scenarios modelled were as follows:

- maximum design single piling scenarios for monopiles and pin pile jacket foundations for fixed Wind Turbines (which included OSPs);
- realistic single piling scenario for monopile foundations for fixed Wind Turbine foundation;
- maximum design concurrent piling for two monopile foundations for fixed Wind Turbines;
- maximum design concurrent piling for two pin pile jacket foundations for fixed Wind Turbines (including OSPs);
- realistic concurrent piling for two monopile foundation for fixed Wind Turbines;
- maximum design consecutive scenario (over 24 hours, assuming no pause between piling events) for monopiles for fixed Wind Turbines;
- maximum design consecutive scenario (over 24 hours, assuming no pause between piling events) for pin pile jacket foundations for fixed Wind Turbines (including OSPs); and
- realistic consecutive scenario (over 24 hours, assuming no pause between piling events) for monopile foundations for the fixed Wind Turbine foundation.

10.10.4 All scenarios were modelled with and without the use of 15 minutes of ADD activation prior to the installation. The inclusion of the ADD in the model assumes that the animal is further away from the piling before being exposed to the piling sound. Impact ranges were modelled for two locations within the Array Area, incorporating the deepest areas within the Site Boundary.

10.10.5 The impact piling scenarios used in the subsea model were based on the MDS parameters, the actual values of hammer energy and duration are expected to be lower.

10.10.6 The maximum hammer energy modelled was 6,250 kJ for the monopile foundations. The piling associated with the OSPs were considered to fall within the parameters used for the fixed jacket foundation scenario, and therefore not modelled separately. A third piling schedule was modelled to represent a likely, or more realistic piling scenario for the monopile foundation type only. The parameters for all three scenarios are presented in Table 10.31 to Table 10.33.

Table 10.31: Impact Piling Schedule Used in the Assessment - Monopile Wind Turbine Foundations

Activity/stage	Duration, minutes	Hammer energy, kJ	Strike rate (strikes per minute)	Number of strikes
Initiation	1	200	5	5
Soft start	20	937.5	30	600
Ramp up	30	937.5 to 6,000	40	1,200
Full power piling	465	6,250	50	23,250
Total piling duration, mins	516			
Total piling duration, hours	8.6			
Total no. of strikes	25,055			
Modelled SEL at 750 m, dB	181.0			

Table 10.32: Impact Piling Schedule Used in the Assessment – Jacket Wind Turbine Foundations (including OSPs)

Activity/Stage	Duration, Minutes	Hammer Energy, kJ	Strike Rate (Strikes per Minute)	Number of Strikes
Initiation	1	675	5	5
Soft start	20	675	30	600
Ramp up	30	675 to 4,500	40	1,200
Full power piling	921	4,500	50	46,050
Total piling duration, mins	972			
Total piling duration, hours	16.2			
Total no. of strikes	47,855			
Modelled SEL at 750 m, dB	176.7			

Table 10.33: Impact Piling Schedule Used in the Assessment - Monopile Wind Turbine Foundations, Realistic Installation Scenario

Activity/stage	Duration, minutes	Hammer energy, kJ	Strike rate (strikes per minute)	Number of strikes
Initiation	1	200	5	5
Soft start	20	937.5	30	600
Ramp up	30	937.5 to 6,000	40	1,200
Full power piling	207	6,000	50	10,350
Total piling duration, mins	258			
Total piling duration, hours	4.3			
Total no. of strikes	12,155			
Modelled SEL at 750 m, dB	180.8			

10.10.7 The modelling for concurrent piling assumed two cases, one to represent the maximum adverse scenario for injury risk (closest potential separation distance of 1 km). The second assumed the widest separation distance (of 20 km) as the maximum adverse scenario for disturbance.

10.10.8 Concurrent piling assessed a single combination of the two modelling locations; one location in the north and one location in the south. For the single impact piling scenario, the maximum design impact ranges were predicted from the north location modelled. Consequently, only the north location predictions have been used for the assessment of impact in this chapter (please see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report, for full detail of the scenarios modelled).

10.10.9 The piling programme (see Table 3.22 in Volume 1, Chapter 3: Project Description) highlights that it is likely to require concurrent piling. This will either be single piling for the foundation throughout the piling window in conjunction with piling for the OSP foundation(s). Or, that there will be concurrent piling throughout the piling window, of either two foundations, or one foundation plus one OSP.

Summary of iPCoD Modelling

10.10.10 To support the assessment of magnitude of impact for piling, the potential for population-level consequences of auditory injury and behavioural disturbance has been conducted using the iPCoD approach for harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal. The expert elicitation process has not been undertaken for white-beaked dolphin (only five key species have been included), and as such the current version of iPCoD (V5.22) does not allow modelling of population trajectories for this species. Relevant MUs for modelling

² https://smruconsulting.com/?page_id=13194

were informed by baseline characterisation in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report.

- 10.10.11 There is limited understanding of how behavioural disturbance and auditory injury affect survival and reproduction in individual marine mammals and consequently how this translates into potential effects at the population-level. The iPCoD framework was developed by SMRU Consulting and the University of St Andrews using a process of expert elicitation to determine how physiological and behavioural changes affect individual vital rates (i.e. the components of individual fitness that affect the probability of survival, production of offspring, growth rate and offspring survival). In 2018 a second expert elicitation process was conducted, which concluded that the effects of auditory injury (then PTS) had significantly less impact on vital rates than was previously thought. This process did not consider minke whales and therefore the effects on the survival and reproduction rates of minke whales have remained unchanged and are more precautionary in comparison to other species.
- 10.10.12 The iPCoD framework applies simulated changes in vital rates to infer the number of animals that may be affected by disturbance as a means to iteratively project the size of the population.
- 10.10.13 For bottlenose dolphin, it was considered most appropriate given the location of the Proposed Development sits within both the GNS MU and Coastal East Scotland MU, to consider the potential impact of disturbance from subsea noise during piling impacts against the sum of the GNS MU and Coastal East Scotland MU population. For harbour porpoise and minke whale, only one MU for each species occurs in the vicinity of the Local Marine Mammal Study Area (IAMMWG, 2023), and the respective population estimates for these MUs have been used for iPCoD modelling: the North Sea MU for harbour porpoise and the CGNS MU for minke whale. The Site Boundary is located within the East Scotland SMU, and telemetry data suggest connectivity between the East Scotland SMU, the Moray Firth SMU and the North Coast and Orkney SMU. Therefore, the grey seal reference population comprises the sum of the population estimates from these three SMUs (SCOS, 2022). For harbour seal the telemetry data suggest connectivity between the East Scotland SMU and the Moray Firth SMU. Therefore, the harbour seal reference population comprises the sum of the population estimates for these two SMUs (SCOS, 2022).
- 10.10.14 The population estimates used to parameterise iPCoD models were taken from IAMMWG (2022) for cetacean species and from Marwood and Stevens, (2024) for both seal species (Table 10.34), alongside vital rates taken from Sinclair *et al.* (2020), presented in Table 10.35.

Table 10.34: MU and Population Estimates for Species Included in iPCoD Models

Species	MU	Population in MU	Population in the UK Portion of MU	Reference
Harbour porpoise	North Sea	346,601	159,632	IAMMWG (2022)
Bottlenose dolphin	Coastal East Scotland MU and GNS MU	226 + 2,022 = 2,248	226 + 1,885 = 2,111	IAMMWG (2022), Cheney <i>et al.</i> (2024)
Minke whale	CGNS	20,118	10,288	IAMMWG (2022)
Grey seal	North Coast and Orkney SMU, Moray Firth SMU, and East Scotland SMU	34,191 + 7,380 + 10,784 = 52,355	N/A	Marwood and Stevens (2024)
Harbour seal	Moray Firth and East Scotland SMU	958 + 364 = 1,322	N/A	Marwood and Stevens (2024)

Table 10.35: Marine Mammal Vital Rates Used to Parameterise iPCoD Models (from Sinclair *et al.* (2020))

Species	Calf/Pup Survival	Juvenile Survival	Adult Survival	Fertility	Age of Independence (years)	Age of First Birth (years)
Harbour porpoise	0.8455	0.85	0.925	0.34	1	5
Bottlenose dolphin (Coastal East Scotland MU)	0.925	0.962	0.98	0.24	3	9
Bottlenose dolphin (all other MUs)	0.80	0.94	0.94	0.25	2	9
Minke whale	0.70	0.77	0.96	0.91	1	9
Grey seal	0.222	0.94	0.94	0.84	1	6
Harbour seal	0.24	0.78	0.80	0.85	1	4

10.10.15 The peak SPL metric has been used to inform the appropriate mitigation range (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) although the dual metric approach is presented in subsea noise modelling and has been used to inform the impact assessment. Therefore, the number of animals that may experience auditory injury for input into the iPCoD models were derived from calculations based on either peak SPL or SEL_{cum}.

10.10.16 Furthermore, calculation of the number of animals that may experience auditory injury assumed a 15-minute implementation of ADD, as per standard industry practice. The numbers of animals for injury taken forward to iPCoD modelling therefore was based upon those with implementation of 15 minute of ADD.

- 10.10.17 Both the maximum temporal scenario (e.g. the impact ranges based on a single piling scenario with fewer animals impacted per day, but over more days) and the maximum spatial scenario (e.g. the concurrent piling scenario with more animals impacted per day, but for fewer days) were modelled.
- 10.10.18 Methods and results of population modelling are presented in full in Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report.

Construction Phase – Auditory Injury

Magnitude of Impact

- 10.10.19 The impact ranges presented in this chapter are based on the NMFS (2024) thresholds for auditory injury only. The Southall *et al.* (2019) values can be found in the subsea noise technical report (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report) together with the TTS predictions based on both NMFS (2024) and Southall *et al.* (2019).
- 10.10.20 Based on modelling (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). the maximum spatial effect for LF cetaceans (minke whale, fin whale and humpback whale) and VHF cetaceans (harbour porpoise) was predicted for concurrent piling of monopile foundations, with a maximum hammer energy of 6,250 kJ; and for HF cetaceans (bottlenose dolphin, white-beaked dolphin, and Risso's dolphin) and pinnipeds (grey seal and harbour seal) was predicted for concurrent piling of jacket foundations, with a maximum hammer energy of 4,500 kJ.
- 10.10.21 The maximum temporal effect was predicted as the longest duration of piling (single piling of jacket foundations). Whilst the effect of auditory injury is considered to result in permanent injury to animals, the risk of animals being exposed to sound levels leading to auditory injury would occur during piling only. As shown in Table 10.19 piling will be intermittent over a three-year piling phase and will occur on up to a maximum of 268 days.

Single Piling Scenarios

- 10.10.22 The maximum predicted auditory injury range (based on the peak SPL metric) for single installation is for the VHF functional hearing group (harbour porpoise) of 2,016 m (monopile foundation scenario). All other species groups are below 460 m (Table 10.36 to Table 10.38). The maximum auditory injury range (based on the peak SPL metric) predicted for the first strike is 511 m (VHF; jacket foundation pile scenario).
- 10.10.23 Whilst the effect of auditory injury is considered to result in permanent reduction in hearing ability for individual animals, the risk of being exposed to sound levels that might lead to auditory injury would only occur during the piling activity. As highlighted in Table 10.19 the impact piling activity will be intermittent over a three-year construction piling phase.

Table 10.36: Potential Marine Mammal Injury Ranges for Pile Installation of Monopile Foundations, Based on the NMFS (2024) peak SPL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, peak SPL (dB re 1 µPa)	Range (m)	
		First Strike	Highest Energy
LF	222 dB re 1 µPa	92	454
HF	230 dB re 1 µPa	51	250
VHF	202 dB re 1 µPa	410	2,016
PCW	223 dB re 1 µPa	85	422

Table 10.37: Potential Marine Mammal Injury Ranges for Pile Installation of Jacket Piles, Based on the NMFS (2024) peak SPL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, peak SPL (dB re 1 µPa)	Range (m)	
		First Strike	Highest Energy
LF	222 dB re 1 µPa	103	264
HF	230 dB re 1 µPa	54	139
VHF	202 dB re 1 µPa	511	1,320
PCW	223 dB re 1 µPa	95	244

Table 10.38: Potential Marine Mammal Injury Ranges for Realistic Pile Installation of Monopile Foundations, Based on the NMFS (2024) peak SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, peak SPL (dB re 1 µPa)	Range (m)	
		First Strike	Highest Energy
LF	222 dB re 1 µPa	92	446
HF	230 dB re 1 µPa	51	245
VHF	202 dB re 1 µPa	410	1,978
PCW	223 dB re 1 µPa	85	414

10.10.24 The maximum predicted accumulated injury range (SEL_{cum}) for single installation, based on the NMFS (2024) impact thresholds, was in respect of the monopile foundation installation (Table 10.39). The LF functional hearing group (minke whale) had the highest range of 14,063 m without ADD activation, and 12,129 m with ADD activation. Other hearing groups that were exposed to accumulated levels that exceeded the auditory injury threshold included the VHF hearing group (harbour porpoise) (2,462 m without ADD activation, and 1,173 m with ADD activation; monopile foundations (Table 10.39)); and the PCW hearing group (grey seal and harbour seal) (821 m without ADD activation, and the threshold was not exceeded with ADD activation; jacket foundations piles (Table 10.40)). The exception was the HF hearing group (bottlenose dolphins and white-beaked dolphin) which was not exposed to accumulated levels that

exceeded the auditory injury threshold for all three scenarios (Table 10.39 to Table 10.41).

Table 10.39: Potential Marine Mammal Injury Ranges for Single Pile Installation Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 $\mu\text{Pa}^2\text{s}$)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 $\mu\text{Pa}^2\text{s}$	14,063	12,129
HF	185 dB re 1 $\mu\text{Pa}^2\text{s}$	N/E	N/E
VHF	155 dB re 1 $\mu\text{Pa}^2\text{s}$	2,462	1,173
PCW	185 dB re 1 $\mu\text{Pa}^2\text{s}$	470	N/E

Table 10.40: Potential Marine Mammal Injury Ranges for Single Pile Installation of Jacket Piles, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 $\mu\text{Pa}^2\text{s}$)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 $\mu\text{Pa}^2\text{s}$	11,719	9,610
HF	185 dB re 1 $\mu\text{Pa}^2\text{s}$	N/E	N/E
VHF	155 dB re 1 $\mu\text{Pa}^2\text{s}$	1,349	N/E
PCW	185 dB re 1 $\mu\text{Pa}^2\text{s}$	821	N/E

Table 10.41: Potential Marine Mammal Injury Ranges for the Realistic Single Pile Installation of Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 $\mu\text{Pa}^2\text{s}$)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 $\mu\text{Pa}^2\text{s}$	14,063	11,954
HF	185 dB re 1 $\mu\text{Pa}^2\text{s}$	N/E	N/E
VHF	155 dB re 1 $\mu\text{Pa}^2\text{s}$	2,403	1,056
PCW	185 dB re 1 $\mu\text{Pa}^2\text{s}$	411	N/E

10.10.25 Results for the instantaneous injury ranges (peak SPL) are the same in all scenarios (single installation scenario, concurrent installation scenario and consecutive installation scenario) therefore results as presented for the single installation apply in all cases (see Table 10.36 to Table 10.38) (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report).

Concurrent Piling Scenarios

- 10.10.26 The potential concurrent cumulative SEL injury ranges for marine mammals are presented in Table 10.42 to Table 10.44.
- 10.10.27 For auditory injury, as noted above, the maximum design is where two adjacent piles are separated by a minimum distance of 1 km due to the maximal overlap of sound propagation contours leading to the maximum generated sound levels.
- 10.10.28 The maximum SEL_{cum} impact range predicted for the LF hearing group (minke whale) and VHF hearing group (harbour porpoise) and arises from the concurrent piling of two monopiles. The largest impact range is 17,402 m for the LF hearing group (minke whale) without ADD activation, and 13,594 m with ADD activation; and 6,798 m for the VHF hearing group (harbour porpoise) without ADD activation, and 2,579 m with ADD activation (Table 10.42).
- 10.10.29 The maximum SEL_{cum} impact range predicted for the PCW hearing group (grey seal and harbour seal) and HF hearing group (bottlenose dolphins and white-beaked dolphin) arises from the concurrent piling of two jacket foundation piles. The largest impact range is 8,907 m for the PCW hearing group (grey seal and harbour seal) without ADD activation and 2,345 m with ADD activation (Table 10.43). The HF hearing group (bottlenose dolphins and white-beaked dolphin) were only exposed to accumulated levels that exceeded the auditory injury threshold for concurrent installation of jacket foundation piles (no ADD) at a range of 10 m (Table 10.43).

Table 10.42: Potential Marine Mammal Injury Ranges for Concurrent Pile Installation Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 µPa ² s)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 µPa ² s	17,402	13,594
HF	185 dB re 1 µPa ² s	N/E	N/E
VHF	155 dB re 1 µPa ² s	6,798	2,579
PCW	185 dB re 1 µPa ² s	5,626	N/E

Table 10.43: Potential Marine Mammal Injury Ranges for Concurrent Pile Installation of Jacket Piles, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 µPa ² s)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 µPa ² s	16,641	12,422
HF	185 dB re 1 µPa ² s	10	N/E
VHF	155 dB re 1 µPa ² s	6,329	1,876
PCW	185 dB re 1 µPa ² s	8,907	2,345

Table 10.44: Potential Marine Mammal Injury Ranges for the Concurrent Realistic Pile Installation of Monopile Foundations, Based on the NMFS (2024) Cumulative SEL Metric (N/E – Threshold Not Exceeded)

Species/Group	AUD INJ Threshold, SEL (dB re 1 $\mu\text{Pa}^2\text{s}$)	Range (m)	
		No ADD	15 min ADD
LF	183 dB re 1 $\mu\text{Pa}^2\text{s}$	16,875	12,832
HF	185 dB re 1 $\mu\text{Pa}^2\text{s}$	N/E	N/E
VHF	155 dB re 1 $\mu\text{Pa}^2\text{s}$	5,626	1,700
PCW	185 dB re 1 $\mu\text{Pa}^2\text{s}$	3,751	N/E

Consecutive Piling Scenarios

- 10.10.30 Modelling of consecutive piling (SEL_{cum} metric) predicted the same injury ranges as the single piling installation scenario for the equivalent monopile foundation, jacket foundation and realistic monopile foundation scenarios and therefore are not presented again (see Table 10.39 to Table 10.41).
- 10.10.31 The number of animals at risk of auditory injury from impact piling is estimated by combining the impact area with the species-specific density estimates. The impact area is calculated using the simplistic equation of area = πr^2 , where r = the predicted range of impact. A summary of the estimated numbers of animals is presented in Table 10.45 and Table 10.46 below, together with an assessment of the proportion of the relevant reference population.

Table 10.45: Numbers of Animals at Risk of Auditory Injury Using the Auditory Injury Peak SPL, Together with the Percentage of Management Unit Population Potentially Affected (N/A = Not Available)

Hearing Group	Species	Density Estimate	Installation scenario	Impact Range (Area km ²)	Number of Animals	% of Reference Population		
						MU	UK Portion of MU	
LF	Minke whale	0.03	Single Monopile Foundation	0.65	<1	0.0001	0.0002	
			Single Jacket Foundation Pile	0.22	<1	0.00003	0.001	
	Fin whale	Qualitative assessment						
	Humpback whale	Qualitative assessment						

Hearing Group	Species	Density Estimate	Installation scenario	Impact Range (Area km ²)	Number of Animals	% of Reference Population	
						MU	UK Portion of MU
HF	Bottlenose dolphin	0.007	Single Monopile Foundation	0.20	<1	0.0001	0.0001
			Single Jacket Foundation Pile	0.06	<1	0.00002	0.00002
	White-beaked dolphin	0.155	Single Monopile Foundation	0.20	<1	0.0001	0.0001
			Single Jacket Foundation Pile	0.06	<1	0.00002	0.00003
	Risso's dolphin	Qualitative assessment					
VHF	Harbour porpoise	0.635	Single Monopile Foundation	12.77	9	0.003	0.006
			Single Jacket Foundation Pile	5.47	4	0.001	0.003
PCW	Grey seal	0.56	Single Monopile Foundation	0.56	<1	0.0006	N/A
			Single Jacket Foundation Pile	0.19	<1	0.0002	N/A
	Harbour seal	0.009	Single Monopile Foundation	0.56	<1	0.0004	N/A
			Single Jacket Foundation Pile	0.19	<1	0.0001	N/A

Table 10.46: Numbers of Animals at Risk of Auditory Injury Using the SEL_{cum} no ADD, together with the Percentage of Management Unit Population Potentially Affected

Hearing Group	Species	Density Estimate	Installation Scenario	Impact Range (Area km ²)	Number of Animals	% of Reference Population	
						MU	UK Portion of MU
LF	Minke whale	0.03	Concurrent Monopile Foundation	951.37	29	0.14	0.28
			Concurrent Jacket Foundation Pile	869.98	27	0.13	0.26
	Fin whale	Qualitative assessment					
	Humpback whale	Qualitative assessment					

Hearing Group	Species	Density Estimate	Installation Scenario	Impact Range (Area km ²)	Number of Animals	% of Reference Population	
						MU	UK Portion of MU
HF	Bottlenose dolphin	0.007	Concurrent Monopile foundation	N/A	N/A	N/A	N/A
			Concurrent jacket foundation pile	0.0003	<1	1 × 10 ⁻⁷	1 × 10 ⁻⁷
	White-beaked dolphin	0.155	Concurrent Monopile foundation	N/A	N/A	N/A	N/A
			Concurrent jacket foundation pile	0.0003	<1	1 × 10 ⁻⁷	1 × 10 ⁻⁷
	Risso's dolphin	Qualitative assessment					
VHF	Harbour porpoise	0.635	Concurrent monopile foundation	145.18	93	0.03	0.06
			Concurrent jacket foundation pile	125.84	80	0.023	0.05
PCW	Grey seal	0.56	Concurrent monopile foundation	99.44	56	0.11	N/A
			Concurrent jacket foundation pile	249.24	140	0.27	N/A
	Harbour seal	0.009	Concurrent monopile foundation	99.44	<1	0.07	N/A
			Concurrent jacket foundation pile	249.24	3	0.23	N/A

*For each species the scenario which presents the maximum range has been presented.

10.10.32 Table 10.45 indicates that there is very low risk of auditory injury to any of the marine mammal species assessed. Instantaneous risk assessment resulting from peak SPL indicates that there is less than one individual at risk for all species except harbour porpoise, where it is possible that nine individuals could be at risk. In all cases, this results in a very low percentage of the reference population being at risk. Risso's dolphin is a HF cetacean and fin whale and

humpback whale are LF cetaceans, and although density information is not available for these species, the maximum injury ranges for the HF hearing group and LF hearing group can be considered to apply.

- 10.10.33 Table 10.46 indicates that the assessment using the SEL_{cum} metric suggests a very low risk of accumulated auditory injury for the HF hearing group species using the modelled impact ranges for the 'no ADD' scenario, given that less than one individual for both bottlenose dolphin and white-beaked dolphin would be at risk. This level of risk can also be applied to Risso's dolphin as a HF cetacean, although there are no density estimates available to enable an estimate of the number of individuals affected. For all other hearing groups, the SEL_{cum} metric suggests a low risk of accumulated auditory injury using the modelled impact ranges for the 'no ADD' scenario. These hearing groups include the LF cetacean group (minke whale) where there is a maximum risk to 29 individuals, representing 0.28% of the UK reference population. This level of risk can also be applied to fin whale and humpback whale as LF cetaceans, although there are no density estimates available to enable an estimate of the number of individuals affected. For the VHF cetacean group (harbour porpoise) there is a maximum risk to 93 individuals, representing 0.06% of the UK reference population. Lastly, for the PCW hearing group there is a maximum risk to 140 grey seal and three harbour seal, representing 0.26% and 0.23% of the MUs, respectively.
- 10.10.34 Due to the numbers of individuals affected, and the resulting proportion of the relevant MUs, the impact is predicted to be of relatively localised scale and spatial extent (in terms of area or proportion of the reference population (low)) for all assessed species. The duration is expected to be temporary, short-term duration (one to seven years duration) with intermittent frequency. Although the impact itself is reversible (i.e. the elevation in underwater sound only occurs during piling), the effect of auditory injury would be permanent. Without mitigation auditory injury could affect a small number of animals leading to changes at an individual level, but these would not be at a scale that would lead to any measurable population-level effects above natural variation. The magnitude is therefore considered to be low.
- 10.10.35 Embedded Mitigation in the form of an outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) will be implemented to further reduce the likelihood of auditory injury. Such mitigation will include deployment of an ADD as recommended in the guidelines (JNCC, 2010). The exact duration of ADD activation will, however, be discussed and agreed with consultees as part of the outline MMMP to be submitted post-consent and in respect of any refinements in the Project Description that may be available at a later stage and included within the outline MMMP (Volume 1, Chapter 3: Project Description; Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). The adherence to a MMMP is considered to reduce the risk of auditory injury from impact piling to negligible.

- 10.10.36 ADDs have commonly been used in marine mammal mitigation at UK OWFs to deter animals from potential injury zones prior to the start of piling. The JNCC (2010) draft guidance for piling mitigation recommends their use, particularly in respect of periods of low visibility or at night to allow 24-hour working. It is considered to be more effective at reducing the potential for injury to marine mammals compared to actions informed by standard mitigation measures (MMOs and PAM) which may have limitations with respect to effective detection over distance (Parsons *et al.*, 2009; Wright and Cosentino, 2015). The outline MMMP details the in combination use of JNCC standard mitigation measures.
- 10.10.37 There are various ADD brands/types available with different sound source characteristics (McGarry *et al.*, 2022) and a suitable device will be selected based on the key species requiring mitigation for the Proposed Development. The selected device will typically be deployed from the piling vessel and activated for a pre-determined duration to allow animals sufficient time to move away from the sound source whilst also reducing the additional sound introduced into the marine environment as far as practicable.

Sensitivity of the Receptor

- 10.10.38 Scientific understanding of the biological impact of auditory threshold shifts is limited to the results of controlled exposure studies on small numbers of captive animals (Finneran, 2015) where TTS was experimentally induced (given it is unethical to induce auditory injury in animals) and thresholds for auditory injury were extrapolated using TTS growth rates. Kastelein *et al.* (2013) demonstrated that hearing impairment as a result of exposure to piling noise is likely to only occur where the source frequencies overlap the range of peak sensitivity for the receptor species, rather than across the whole frequency hearing spectrum. The study demonstrated that for simulated piling noise (broadband spectrum), harbour porpoise hearing around 125 kHz (the key frequency for echolocation) was not affected. Rather, a measurable, but relatively small, threshold shift in hearing was observed at frequencies of 4 kHz to 8 kHz, as most of the energy from the simulated piling occurred in the lower frequencies (Kastelein *et al.*, 2013).
- 10.10.39 The duty cycle of fatiguing noise is also likely to affect the magnitude of a hearing shift, (i.e. hearing may recover to some extent during any inter-pulse intervals (Kastelein *et al.*, 2014)). Other studies reported that whilst a threshold shift can accumulate across multiple exposures, the resulting shift will be less than the shift from a single, continuous exposure with the same total SEL (Finneran, 2015).
- 10.10.40 In order to reduce exposure to noise, cetaceans are able to undertake self-mitigation measures (e.g. the animal can change the orientation of its head so that noise levels reaching the ears are reduced), or they can suppress hearing sensitivity by one or more neurophysiological auditory response control mechanisms in the middle ear, inner ear, and/or central nervous system. Kastelein *et al.* (2020) highlighted the lack of reproducibility of TTS in a harbour porpoise after it was exposed to repeated airgun noises, and the authors suggested self-mitigation may have led to the discrepancies.

- 10.10.41 In comparison to cetaceans, seals are less dependent on hearing for foraging but may rely on sound for communication and predator avoidance (e.g. Deecke *et al.*, 2002). Seals can detect swimming fish with their vibrissae (Schulte-Pelkum *et al.*, 2007) but, in certain conditions, they may also listen to noises produced by vocalising fish in order to hunt for prey. Consequently, the ecological consequences of a significant noise-induced threshold shift in seals may be a reduction in fitness, reproductive output and longevity (Kastelein *et al.*, 2018). A study by Hastie *et al.* (2015a) reported that, based on calculations of the sound exposure of tagged harbour seal during the construction of the Lincs OWF (Greater Wash, UK), at least half of the tagged seals could have received noise levels from pile driving that exceeded auditory injury thresholds for pinnipeds. Nevertheless, population estimates indicated that the relevant population trend at that time was increasing and therefore (whilst there are many other ecological factors that will influence the population health) this indicated that predicted levels of auditory injury did not affect a sufficient number of individuals to cause a decrease in the population trajectory (Hastie *et al.*, 2015b). Hastie *et al.* (2015a) did note that the paucity of data on effects of noise on seal hearing means the exposure criteria used are intentionally conservative and therefore the predicted numbers of individuals in this study thought to be affected by auditory injury would also have been highly conservative.
- 10.10.42 Despite the uncertainty in the ecological effects of auditory injury on seals, seals rely on hearing much less than cetaceans and therefore would exhibit some tolerance (i.e. the effect is unlikely to cause a change in either reproduction or survival rates). In addition, it has been proposed that seals may be able to self-mitigate (i.e. reduce their hearing sensitivity in the presence of loud noises in order to reduce their perceived noise level).
- 10.10.43 Booth and Heinis (2018) presents the conclusions from the expert elicitation workshop on the effects of an auditory injury on vital rates in marine mammal species. The aim of the workshop was to update the relevant parameters for the iPCoD model and was focused on the potential for auditory injury from LF broadband noise (i.e. pile driving). Key conclusions were that individuals predicted to be at risk of exceeding the auditory injury thresholds did not mean the animals were deaf, but that there could be a reduction in hearing sensitivity within a specific hearing range.
- 10.10.44 Conclusions were that effects on vital rates were lowest on harbour porpoise (VHF), and harbour and grey seal (PCW). Effects were thought to be slightly larger for delphinid species (HF), because dolphins use lower frequencies for communication, rather than they were more sensitive. However, for both hearing groups, the conclusions were that auditory injury was unlikely to result in an impact to either survival or reproductive rates.
- 10.10.45 LF cetaceans were not assessed in this workshop, however, the generalised hearing range for this hearing group is between 7 Hz to 36 kHz (NMFS, 2024) suggesting a potential greater overlap between frequencies used by LF cetaceans and impact piling than for other cetacean hearing groups.

- 10.10.46 All species groups are therefore considered to be able to avoid or adapt behaviour (adaptability) have some tolerance (resilience) but with limited ability to recover from any impact as auditory injury is permanent. The sensitivity of all species is therefore, conservatively considered to be medium.

Significance of the Effect

- 10.10.47 Overall, including the implementation of the Embedded Mitigation measures, the magnitude of the impact is deemed to be negligible. The sensitivity of all marine mammal receptors is medium. The effect will therefore be of negligible to minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.48 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Construction Phase – Disturbance from Impact Piling

- 10.10.49 Disturbance ranges have been calculated by applying a dose-response approach (D/R), using the Graham *et al.* (2017) response functions. At the time of writing, it is understood that the Graham *et al.* (2017) response functions are likely to be highly over precautionary (Thompson *et al.*, 2025), therefore as there is not at this time an agreed alternative method, both the full D/R (>120 dB SEL_{ss}) and the capped (> 140 dB SEL_{ss}) are presented in Table 10.47 and Table 10.48 for cetaceans. As context, the number of animals at risk of disturbance has also been estimated using the mild disturbance (140 dB rms) and strong disturbance (160 dB_{rms}) thresholds from NMFS (2005) and is presented in Table 10.50.
- 10.10.50 For cetacean species, the impact at population-level has been presented for both the full MU and the UK portion of the reference population for the D/R assessment (as requested by Statutory Nature Conservation Bodies (SNCBs), see Table 10.12). The assessment of impact at population-level using the mild/strong disturbance thresholds has only presented the percentage of the UK portion of the MU. The MDS estimates presented below relate to the maximum single and concurrent spatial scenario (monopile foundation) and maximum temporal scenario (jacket foundation pile).
- 10.10.51 The D/R methodology from Whyte *et al.* (2020) has been used for both seal species (Table 10.50 and Table 10.51). The impact at population-level has been assessed against the combined North Coast and Orkney SMU, Moray Firth SMU and East Scotland SMU for grey seal; and the combined Moray Firth SMU and East Scotland SMU for harbour seal.

Table 10.47: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Graham *et al.*, 2017), and the Percentage of the Population at Risk at both the Full MU and the UK Portion of the MU for the Maximum Spatial Scenario (Monopile Foundation)

Species	Scenario	Number of Animals (>120 dB)	Reference Population		Number of Animals (>140 dB)	Reference Population	
			Full MU	UK MU Portion		Full MU	UK MU Portion
Harbour porpoise	Single	9,211	2.66%	5.77%	3,651	1.05%	2.29%
	Concurrent	12,776	3.69%	8.00%	5,215	1.50%	3.27%
Bottlenose dolphin	Single	102	4.54%	4.83%	41	1.82%	1.94%
	Concurrent	141	6.27%	6.68%	58	2.58%	2.75%
White-beaked dolphin	Single	2,249	5.12%	6.61%	892	2.03%	2.62%
	Concurrent	3,119	7.10%	9.17%	1,273	2.90%	3.74%
Minke whale	Single	436	2.17%	4.24%	173	0.86%	1.68%
	Concurrent	604	3.00%	5.87%	247	1.23%	2.40%

Table 10.48: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Graham *et al.*, 2017), and the Percentage of the Population at Risk at both the Full MU and the UK Portion of the MU for the Maximum Temporal Scenario (Jacket Foundation Pile)

Species	Scenario	Number of Animals (>120 dB)	Reference Population		Number of Animals (>140 dB)	Reference Population	
			Full MU	UK MU Portion		Full MU	UK MU Portion
Harbour porpoise	Single	7,781	2.24%	4.87%	2,829	0.82%	1.77%
	Concurrent	11,628	3.35%	7.28%	4,439	1.28%	2.78%
Bottlenose dolphin	Single	86	3.83%	4.07%	32	1.42%	1.52%
	Concurrent	129	5.74%	6.11%	49	2.18%	2.32%
White-beaked dolphin	Single	1,900	4.32%	5.58%	691	1.57%	2.03%
	Concurrent	2,839	6.46%	8.34%	1,084	2.47%	3.19%
Minke whale	Single	368	1.83%	3.58%	134	0.67%	1.30%
	Concurrent	550	2.73%	5.35%	210	1.04%	2.04%

Table 10.49: The Number of Animals at Risk of Disturbance Using the Mild and Strong Disturbance Metrics (140 dB_{rms} and 160 dB_{rms} Respectively), and the Resulting Percentage of the Population at Risk Using the UK Portion of the MU for MDS (Monopile Foundation)

Species	Scenario	Number of animals		Reference population UK MU portion	
		Mild	Strong	Mild	Strong
Harbour porpoise	Single	27,406	1,551	17.17%	0.97%
	Concurrent	40,439	2,563	25.33%	1.61%
Bottlenose dolphin	Single	303	18	14.35%	0.85%
	Concurrent	446	29	21.13%	1.37%
White-beaked dolphin	Single	6,690	379	19.66%	1.11%
	Concurrent	9,871	626	29.01%	1.84%
Minke whale	Single	1,295	74	12.59%	0.72%
	Concurrent	1,911	122	18.58%	1.19%

Table 10.50: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Whyte *et al.*, 2020), and the Resulting Percentage of the Population at Risk Using the SMU Reference Populations from the North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU Combined for Grey Seal, and the Moray Firth SMU and the East Scotland SMU Combined for Harbour Seal for Maximum Spatial Scenario (Monopile Foundation)

Species	Scenario	Number of animals			Reference population Impact		
		Mean	Upper 95%	Lower 95%	Mean	Upper 95%	Lower 95%
Grey seal	Single	1,235	2,453	83	2.36%	4.69%	0.16%
	Concurrent	1,772	3,459	148	3.38%	6.61%	0.28%
Harbour seal	Single	8	17	<1	0.61%	1.29%	0.01%
	Concurrent	9	18	<1	0.68%	1.36%	0.02%

Table 10.51: The Number of Animals at Risk of Disturbance Using the Dose-Response Approach (Whyte *et al.*, 2020), and the Resulting Percentage of the Population at Risk Using the SMU Reference Populations from the North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU Combined for Grey Seal, and the Moray Firth SMU and the East Scotland SMU Combined for Harbour Seal Maximum Temporal Scenario (Jacket Foundation Pile)

Species	Scenario	Number of animals			Reference population Impact		
		Mean	Upper 95%	Lower 95%	Mean	Upper 95%	Lower 95%
Grey seal	Single	904	1,825	52	1.73%	3.49%	0.10%
	Concurrent	1,467	2,925	97	2.80%	5.59%	0.19%
Harbour seal	Single	7	15	<1	0.53%	1.13%	0.01%
	Concurrent	8	17	<1	0.61%	1.29%	0.01%

Magnitude of Impact

Harbour Porpoise

- 10.10.52 For the single piling scenario up to 3,651 individuals (based upon a density of 0.635 animals per km², Table 10.15) are estimated to be at risk of disturbance (using the >140 dB D/R methodology) (Table 10.47). This equates to 2.29% of the UK portion of the MU (1.05% of the full MU). In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 1,551 individuals, equating to 0.97% of the UK portion of the MU (Table 10.49).
- 10.10.53 For the MDS concurrent piling scenario (two monopile foundations), up to 5,215 individuals are estimated to be at risk of disturbance (using the >140 dB D/R methodology) (Table 10.47, Figure 10.7). This equates to 3.27% of the UK portion of the MU (1.50% of the full MU). In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 2,563 individuals, equating to 1.61% of the UK portion of the MU (Table 10.49).
- 10.10.54 Figure 10.7 illustrates that there is some overlap of the 120 to 125 dB SEL_{ss} subsea noise contours for both the single and concurrent scenario with the Southern North Sea SAC, designated for harbour porpoise. However, as the Southern North Sea SAC is 203.4 km from the Proposed Development it is anticipated that the received level from piling will have likely lost much of the impulsive characteristics as these levels of subsea noise are below mild disturbance, especially within the southern area of the Southern North Sea SAC where the subsea noise contours do not overlap.
- 10.10.55 Whilst the assessment for the number of individuals at risk of disturbance has been based on the precautionary single density estimate (Table 10.47), Figure 10.7 is presented with the density surface from Gilles *et al.* (2025) to visually illustrate that the highest density is not consistently found across the area potentially impacted and therefore the numbers of individuals affected is likely to be an overestimate.

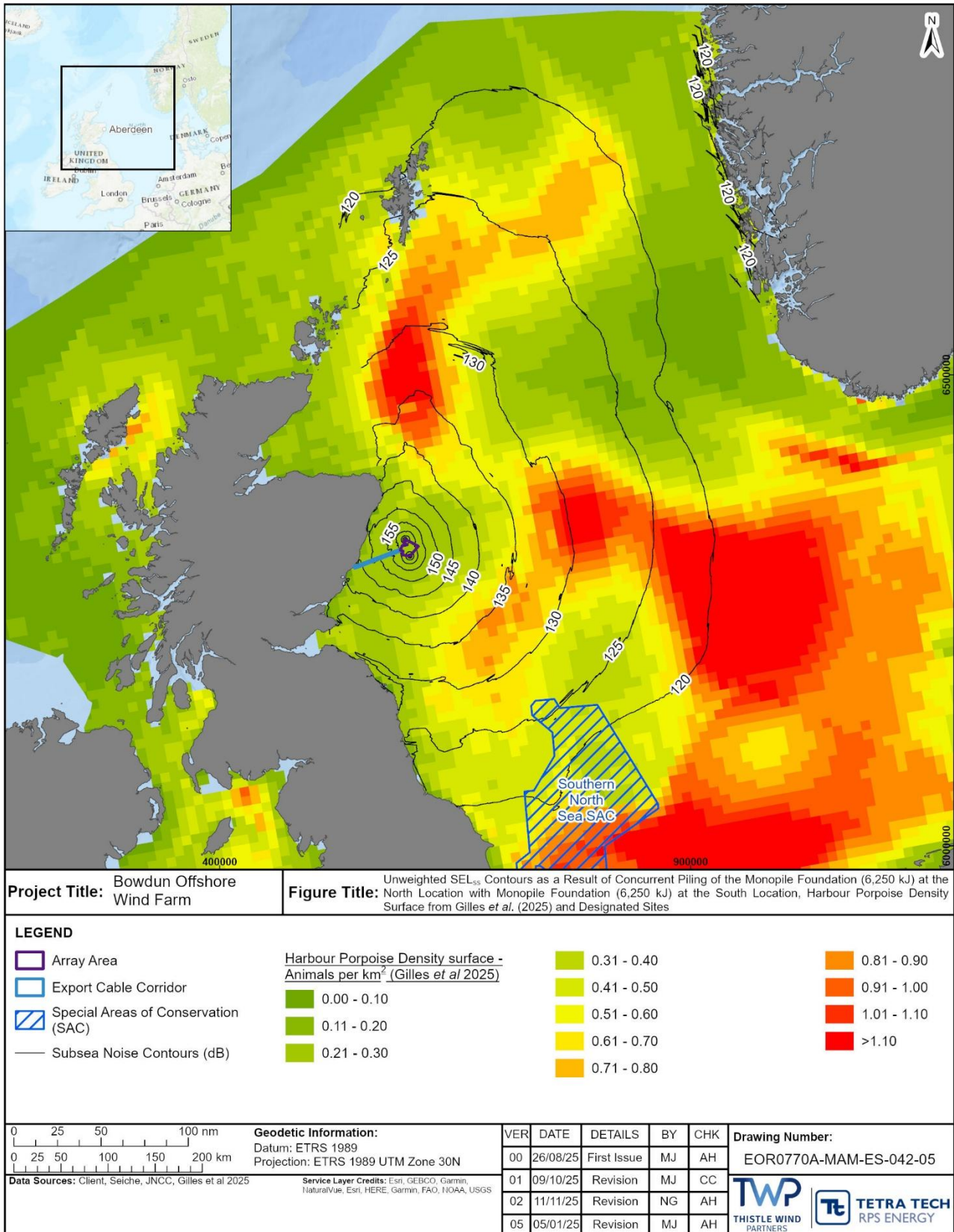


Figure 10.7: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North location with Monopile Foundation (6,250 kJ) at the South Location, Harbour Porpoise Density and Designated Sites

- 10.10.56 Population modelling was run for harbour porpoise to explore the potential of disturbance during piling to affect the population trajectory over time, using the number of individuals at risk of disturbance from both the 140 dB capped contours and the full 120 dB contours as a comparison. Two scenarios were run; 1) a single piling occurrence scenario (foundation or OSP) (maximum temporal scenario) and 2) concurrent foundation (a foundation plus foundation, or foundation plus OSP) (maximum spatial scenario). The graphs comparing the un-impacted and impacted populations for each scenario are presented in Figure 10.8 to Figure 10.9.
- 10.10.57 Results of the iPCoD modelling for harbour porpoise against the MU population for the single installation scenario (maximum temporal scenario) (Figure 10.8) showed that the median ratio of the impacted population to the un-impacted population at five, ten and 25 years was 0.99, which indicates there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.8. The population modelling therefore suggests that there is no predicted impact to the population from the construction of the Proposed Development over the 25-year modelled period from the single installation scenario.
- 10.10.58 Results of the iPCoD modelling for harbour porpoise against the MU population for the concurrent scenario (maximum spatial scenario) (Figure 10.9) showed that the median ratio of the impacted population to the un-impacted population at both five, ten and 25 years was one and the mean was 0.99, which indicates there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.9. The population modelling suggests that there is no predicted impact to the population from the construction of the Proposed Development over the 25-year modelled period from the concurrent installation scenario.
- 10.10.59 Further, the modelling suggests that there is no discernible difference in the population dynamics between the maximum temporal scenario (Figure 10.8) and the maximum concurrent scenario (Figure 10.9).

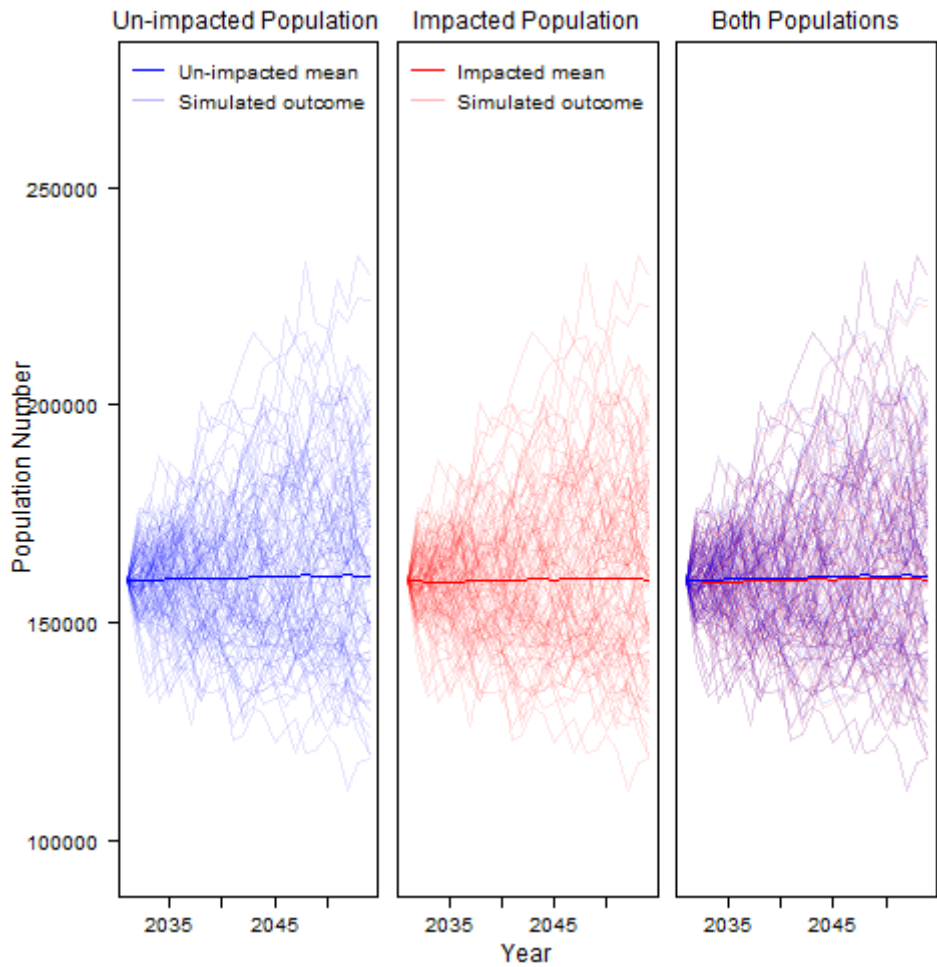


Figure 10.8: Simulated Harbour Porpoise Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Installation Scenario (Maximum Temporal Scenario)

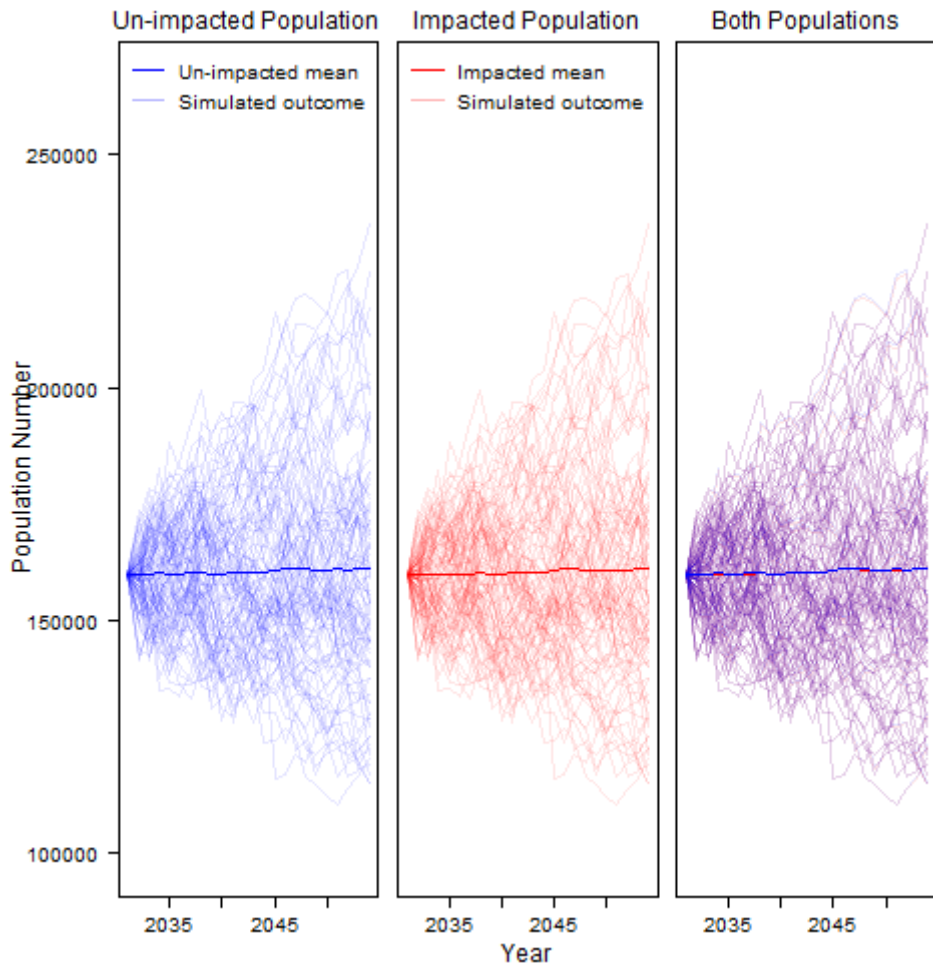


Figure 10.9: Simulated Harbour Porpoise Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation Scenario (Maximum Spatial Scenario)

10.10.60 The extent of the impact is anticipated to be over a limited scale or geographic extent (in terms of proportion of the reference population). This is supported by the low percentage of the population estimated to be affected. The long-term population modelling also predicts no population impact from the assessed impact piling. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, there would be no population-level consequences of disturbance. The magnitude of impact for harbour porpoise is therefore low.

Bottlenose Dolphin and Risso’s Dolphin

10.10.61 For bottlenose dolphin in the single piling scenario, up to 41 individuals (based upon a density of 0.007 animals per km², Table 10.15) are estimated to be at risk of disturbance (using the >140 D/R methodology) Table 10.47). This equates to 1.94% of the UK portion of the MU (1.82% of the full MU). In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 18 individuals, equating to 0.85% of the UK portion of the MU (Table 10.49).

- 10.10.62 For the concurrent piling scenario, up to 58 individuals are estimated to be at risk of disturbance (using the >140 D/R methodology) (Table 10.47). This equates to 2.72% of the UK portion of the MU. In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 29 animals, equating to 1.37% of the UK portion of the MU (Table 10.49).
- 10.10.63 Due to the landmass to the north-east of the Local Marine Mammal Study Area it is uncertain which subsea noise contour would overlap with the Moray Firth SAC, but it is assumed that the MDS would be an overlap of the 130 to 135 dB SEL_{ss} subsea noise contours for both the single and concurrent scenario (Figure 10.11). The coastal area where the inshore ecotype found in the Moray Firth is likely to inhabit lies approximately 157 km from the Proposed Development and at this distance the received level from piling will have likely lost much of the impulsive characteristics. However, a wide range of sound contours modelled reach the coastal areas, including the region of the cable route (with a range of 140 to 160 dB SEL_{ss}) and therefore the noise levels within these areas may cause mild and strong disturbance to the inshore ecotype bottlenose dolphin which is distributed within Coastal East Scotland MU.

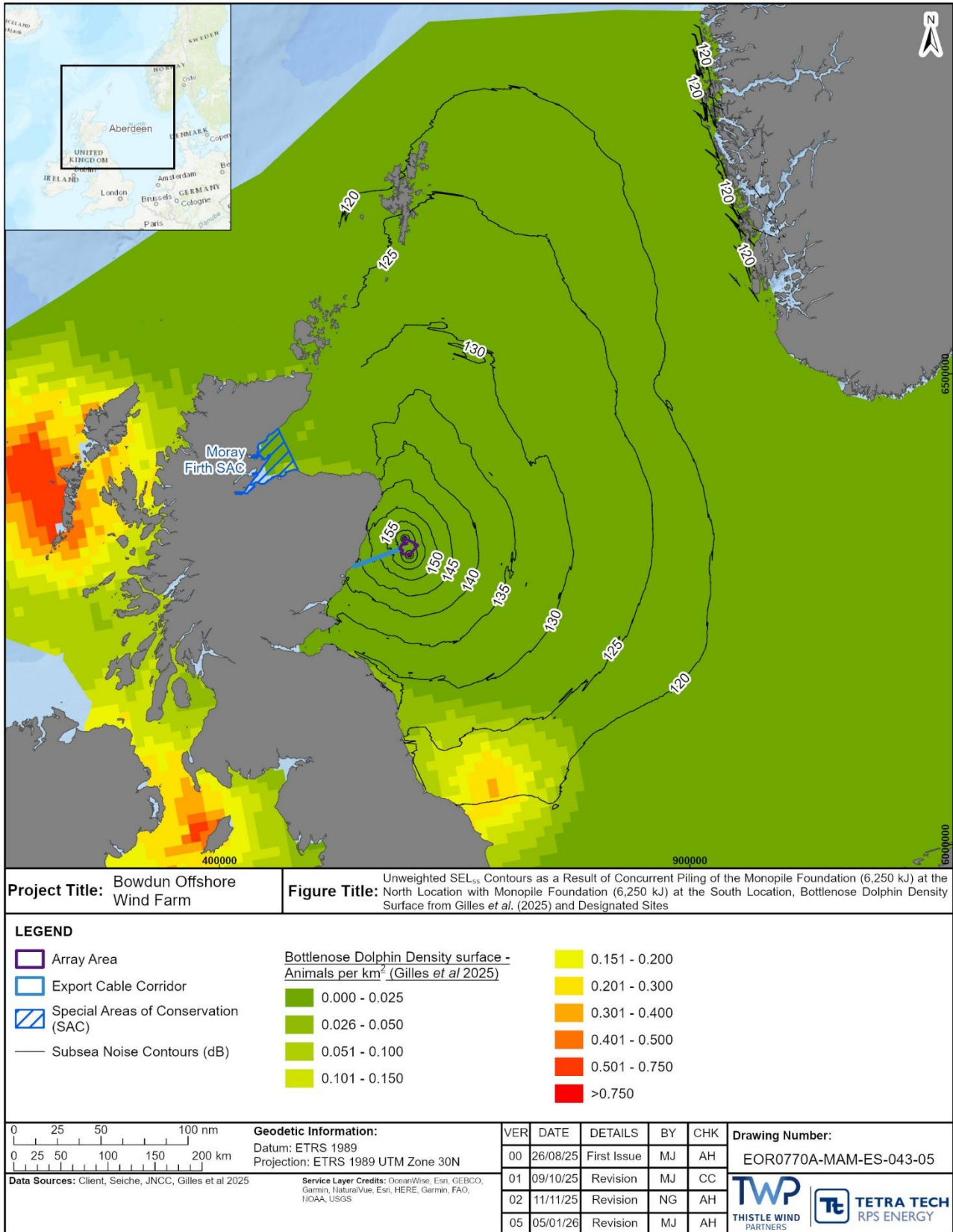


Figure 10.10: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Bottlenose Dolphin Density Surface from Gilles *et al.* (2025) and Designated Sites

- 10.10.64 Population modelling was run for bottlenose dolphin twice using different vital rates, one from Coastal East Scotland MU and the other from the GNS MU, and the graphs comparing the un-impacted and impacted populations for both vital rates for each scenario are presented in Figure 10.11 and Figure 10.12 and Figure 10.13 and Figure 10.14 respectively.
- 10.10.65 Results of the iPCoD modelling for bottlenose dolphin against the Coastal East Scotland MU vital rates for the single installation scenario (maximum temporal scenario) and the concurrent scenario (maximum spatial scenario) (Figure 10.11 and Figure 10.12) showed a general increase in the populations of the combined Coastal East Scotland MU and GNS MU reference populations. The median ratio of the impacted population to the un-impacted population at five, ten and 25 years was one for both the temporal and spatial scenario, which indicates there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in both Figure 10.11 and Figure 10.12. The population modelling therefore suggests that there is no predicted impact to the Coastal East Scotland MU and GNS MU bottlenose dolphin population from the construction of the Proposed Development over the 25-year modelled period from the single installation scenario or the concurrent scenario.
- 10.10.66 For the population of the combined Coastal East Scotland MU and GNS MU bottlenose dolphin using the GNS vital rates, both the impacted and un-impacted populations show a decline over the 25 year modelled period for the single installation scenario (Figure 10.13) and the concurrent scenario (Figure 10.14). The results of the iPCoD modelling for bottlenose dolphin using the GNS MU vital rates for the single installation scenario (Figure 10.13) and the concurrent scenario (Figure 10.14) showed that the median ratio of the impacted population to the un-impacted population at both five, ten and 25 years was one which indicates that there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.13 and Figure 10.14. The population modelling therefore suggests that there is no predicted impact to the Coastal East Scotland MU and GNS MU bottlenose dolphin population from the construction of the Proposed Development over the 25-year modelled period from the single installation scenario or the concurrent scenario.

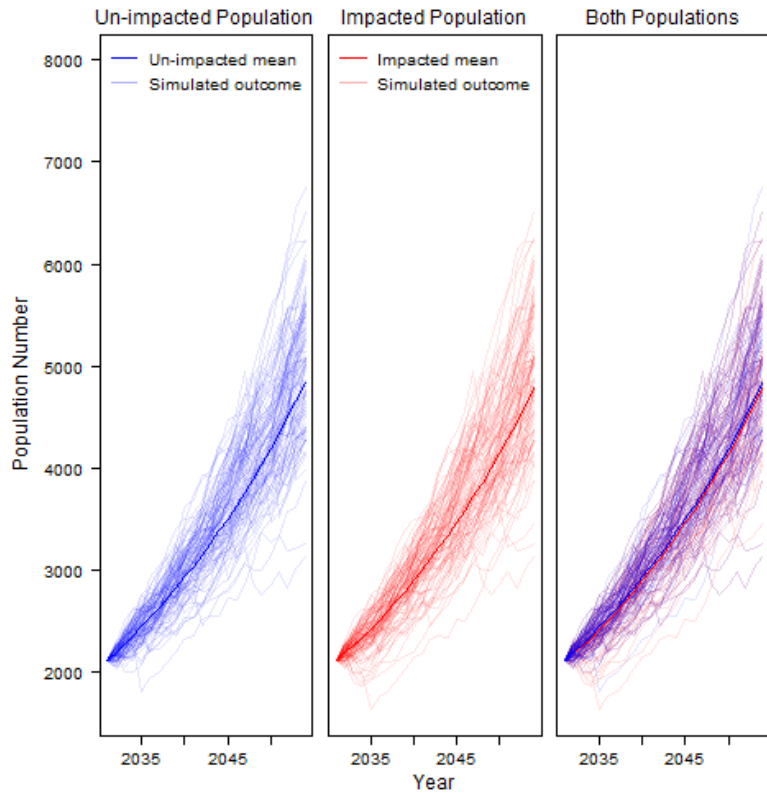


Figure 10.11: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario Using the Coastal East Scotland MU Vital Rates)

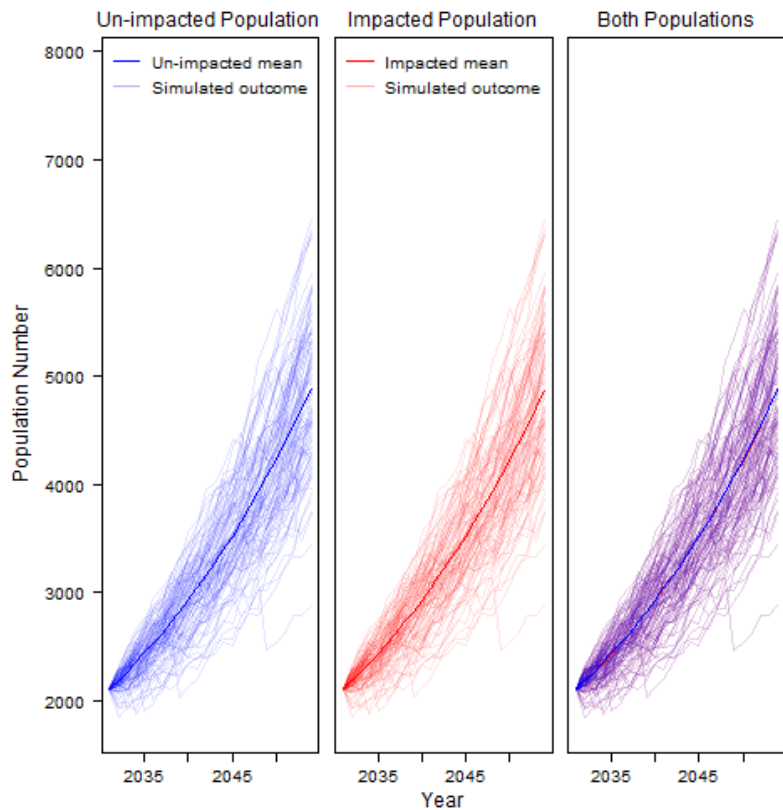


Figure 10.12: Simulated Bottlenose Dolphin Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario Using the Coastal East Scotland MU Vital Rates)

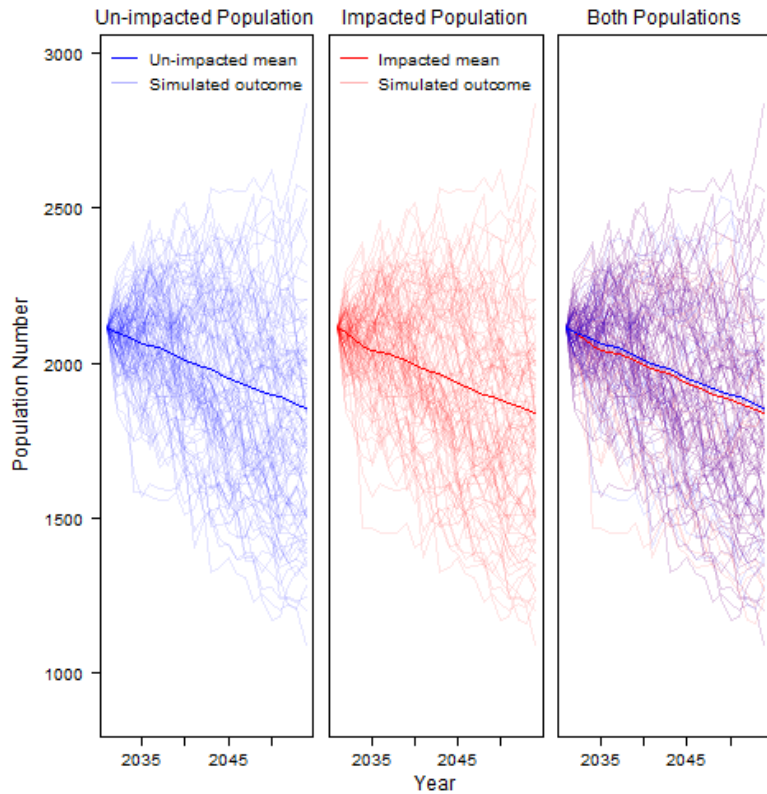


Figure 10.13: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario Using the GNS MU Vital Rates)

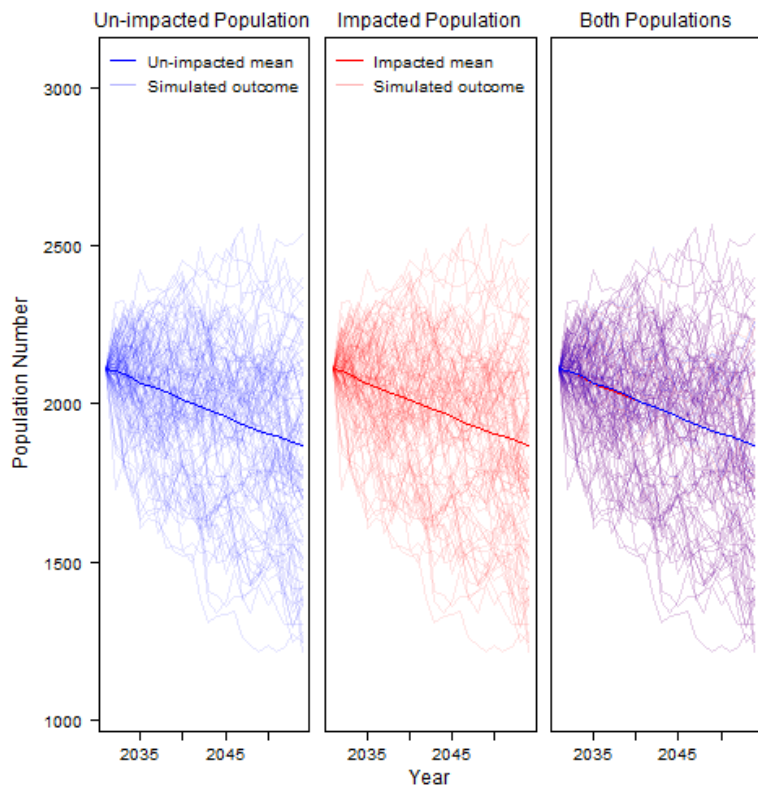


Figure 10.14: Simulated Bottlenose Dolphin Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario Using the GNS MU Vital Rates)

- 10.10.67 The extent of the impact is anticipated to be over a limited scale or geographic extent (in terms of proportion of the reference population), which is supported by the low percentage of the reference population estimated to be affected. The long-term population modelling also predicts no population impact from the assessed impact piling, although both the un-impacted and impacted populations show a decline over time. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, there would be no population-level consequences of disturbance. The magnitude of impact for bottlenose dolphin is therefore low.
- 10.10.68 Although there have been sightings of Risso's dolphin just north of the Local Marine Mammal Study Area (see Paragraph 10.6.7) there are no density estimates available to enable quantitative assessment. Risso's dolphin is in the same functional hearing group as bottlenose dolphin and therefore the magnitude of impact is anticipated to be the same or lower than for bottlenose dolphin. The magnitude is therefore low for both species.

White-beaked Dolphin

- 10.10.69 For the single piling scenario, up to 892 individuals (based upon a density of 0.155 animals per km², Table 10.15) are estimated to be at risk of disturbance (using the >140 D/R methodology) (Table 10.47). This equates to 2.62% of the UK portion of the MU (2.03% of the full MU). The number of individuals at risk of strong disturbance threshold is up to 379 individuals, equating to 1.11% of the UK portion of the MU (Table 10.49).
- 10.10.70 For the concurrent piling scenario, up to 1,273 individuals are estimated to be at risk of disturbance (using the >140 D/R methodology) (Table 10.47, Figure 10.15). This equates to 3.74% of the UK portion of the MU (2.90% of the full MU). The number of individuals at risk of strong disturbance threshold is up to 626 individuals, equating to 1.84% of the UK portion of the MU (Table 10.49).

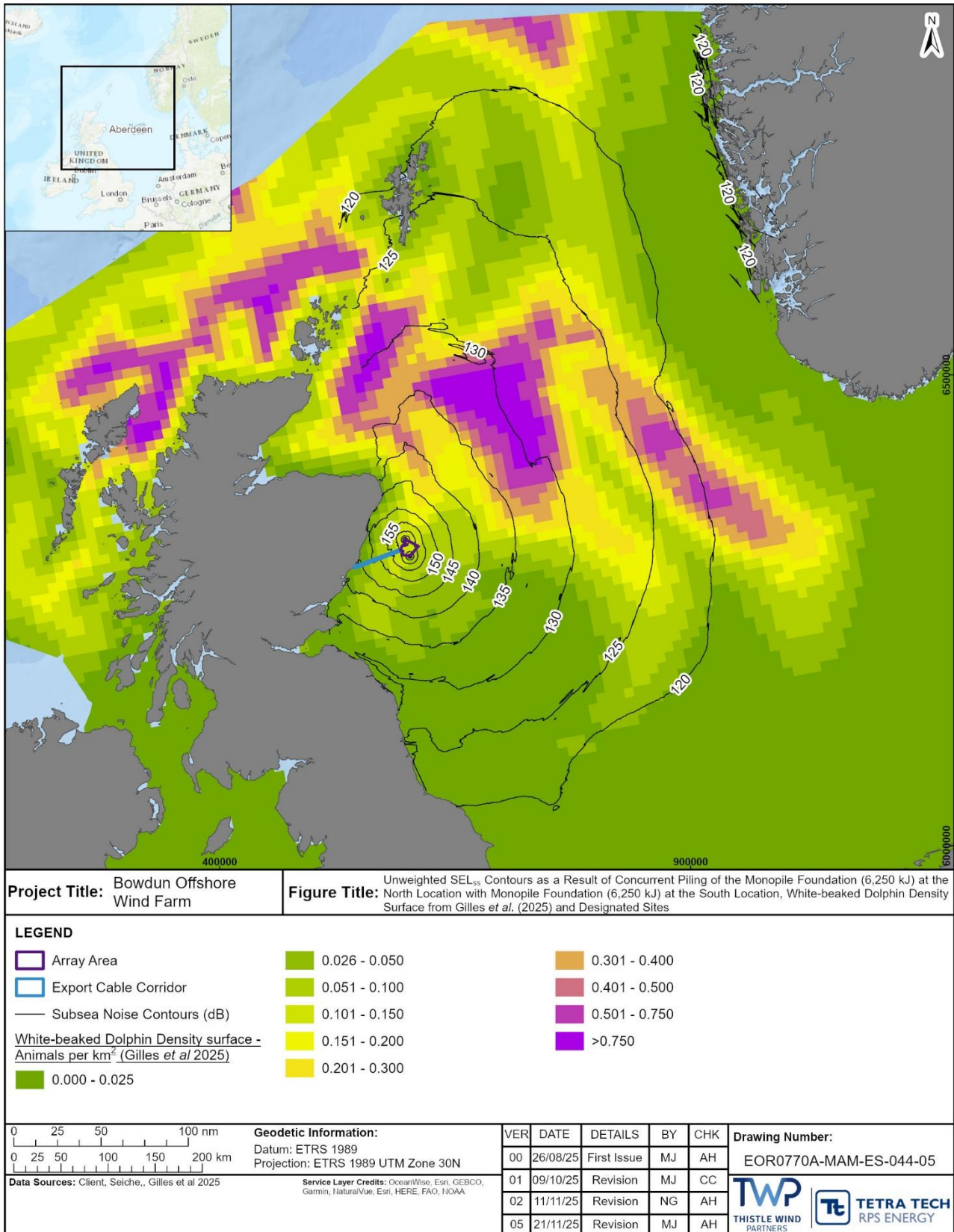


Figure 10.15: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, White-beaked Dolphin Density Surface from Gilles *et al.* (2025) and Designated Sites

- 10.10.71 iPCoD did not facilitate population modelling for white-beaked dolphin, therefore no population modelling was carried out for this species. There are no MPAs designated for this species within the Regional Marine Mammal Study Area.
- 10.10.72 Although the numbers of animals disturbed appear high at first glance, it is important to consider the extent of the impact is anticipated to be over a limited spatial scale but may lead to a medium geographic extent (in terms of proportion of the reference population), this is supported by the moderate percentage of the population estimated to be affected using the SCANS IV data estimated density. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, it is considered unlikely to lead to population-level consequences of disturbance. Consequently, as a precaution the magnitude of impact for white-beaked dolphin is medium.

Minke Whale, Fin Whale and Humpback Whale

- 10.10.73 For minke whale in the single piling scenario, up to 173 individuals (based upon a density of 0.03 animals per km², Table 10.15) are estimated to be at risk of disturbance (using the >140 dB D/R methodology) (Table 10.47). This equates to 1.68% of the UK portion of the MU (0.86% of the full MU). In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 74 individuals, equating to 0.72% of the UK portion of the MU (Table 10.49).
- 10.10.74 For the concurrent piling scenario, up to 247 individuals are estimated to be at risk of disturbance (using the >140 dB D/R methodology) (Table 10.47). This equates to 2.40% of the UK portion of the MU (1.23% of the full MU). In comparison, the number of individuals at risk of disturbance using the strong disturbance threshold is up to 122 individuals, equating to 1.19% of the UK portion of the MU (Table 10.49).
- 10.10.75 There is overlap with 135 to 150 dB SEL_{ss} subsea noise contours with the Southern Trench ncMPA for minke whale in the Regional Marine Mammal Study Area (Figure 10.16). However, these levels are below the National Marine Fisheries Service (NMFS, 2005) threshold for disturbance from an impulsive noise source (160 dB SPL_{rms}). According to the behavioural response severity matrix suggested by Southall *et al.* (2021), such low level disturbance (scoring between 0 to 3 on a 0 to 9 scale) could lead to mild disruptions of normal behaviours, though prolonged or sustained behavioural effects (including displacement) are unlikely to occur. The predicted noise levels are therefore not anticipated to result in significant disturbance (i.e. disturbance resulting in a long-term decline, changes in distribution, or changes in behaviour that reduce the ability to feed, breed or survive).

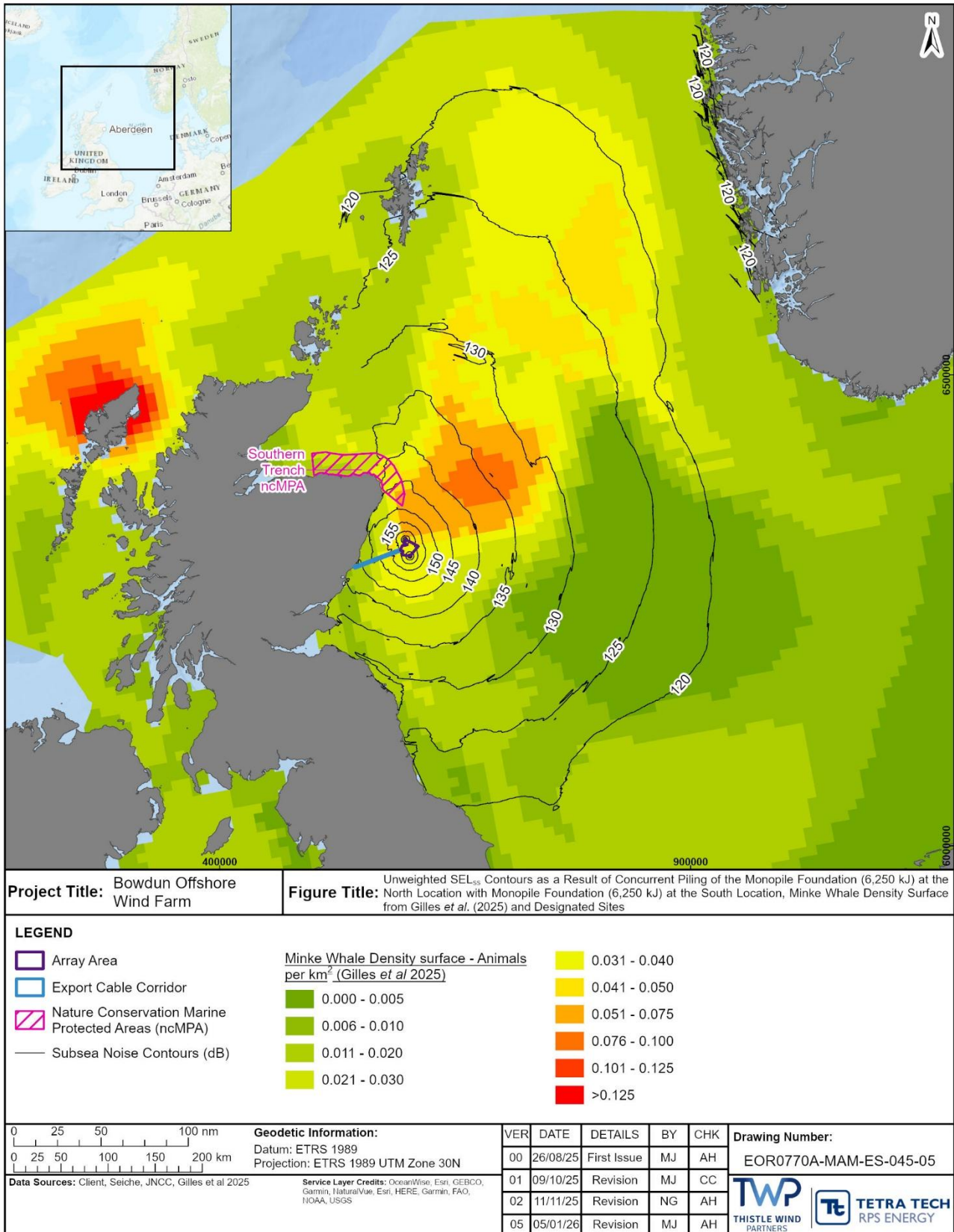


Figure 10.16: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Minke Whale Density and Designated Sites

- 10.10.76 Notwithstanding the relatively low proportion of minke whale population estimated to be at risk of disturbance, population modelling was run for minke whale, and graphs comparing the un-impacted and impacted populations for each scenario are presented in Figure 10.17 to Figure 10.18.
- 10.10.77 For both scenarios (Figure 10.17 and Figure 10.18), whilst both the impacted and un-impacted populations show a slight decline over the 25 year modelled period, results of the iPCoD modelling for minke whale against the CGNS MU population for the single monopile installation scenario and concurrent scenario showed that the median ratio at five, ten and 25 years was 1, which indicates there is no significant difference between population trajectories for an un-impacted and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). At five, ten and 25 years the impacted population estimate was the same as the un-impacted scenario. Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.17 and Figure 10.18. The population modelling suggests that there is no predicted impact to the population from the construction of the Proposed Development over the 25-year modelled period from the single monopile foundation installation scenario or concurrent foundation installation scenario.

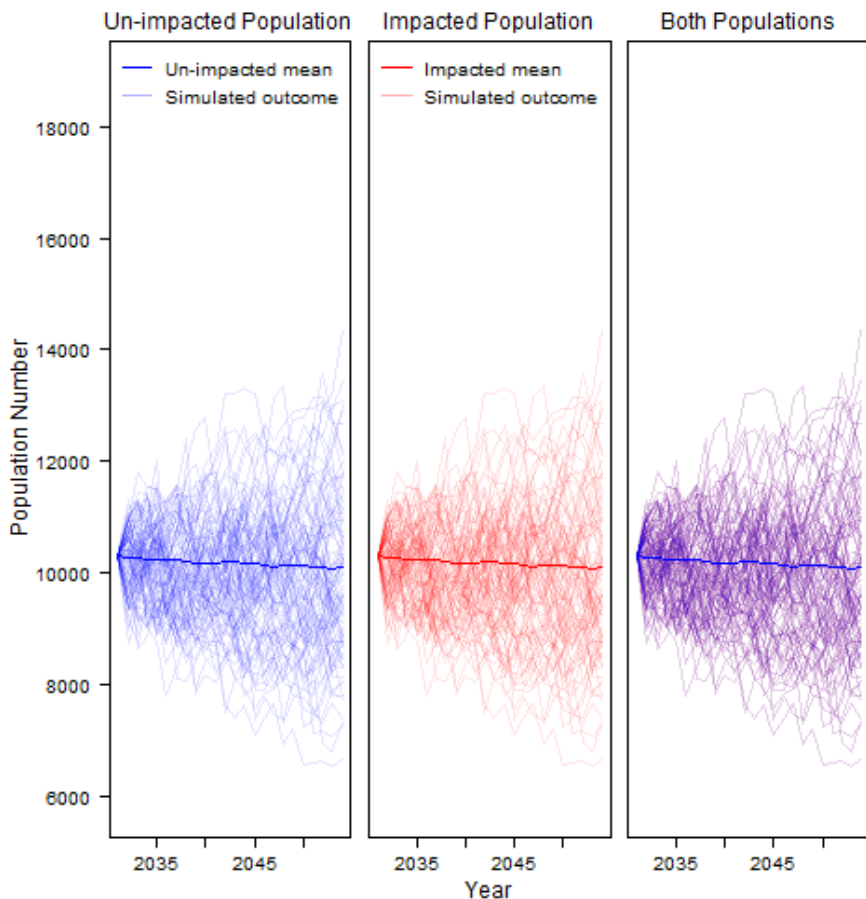


Figure 10.17: Simulated Minke Whale Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation (Maximum Temporal Scenario)

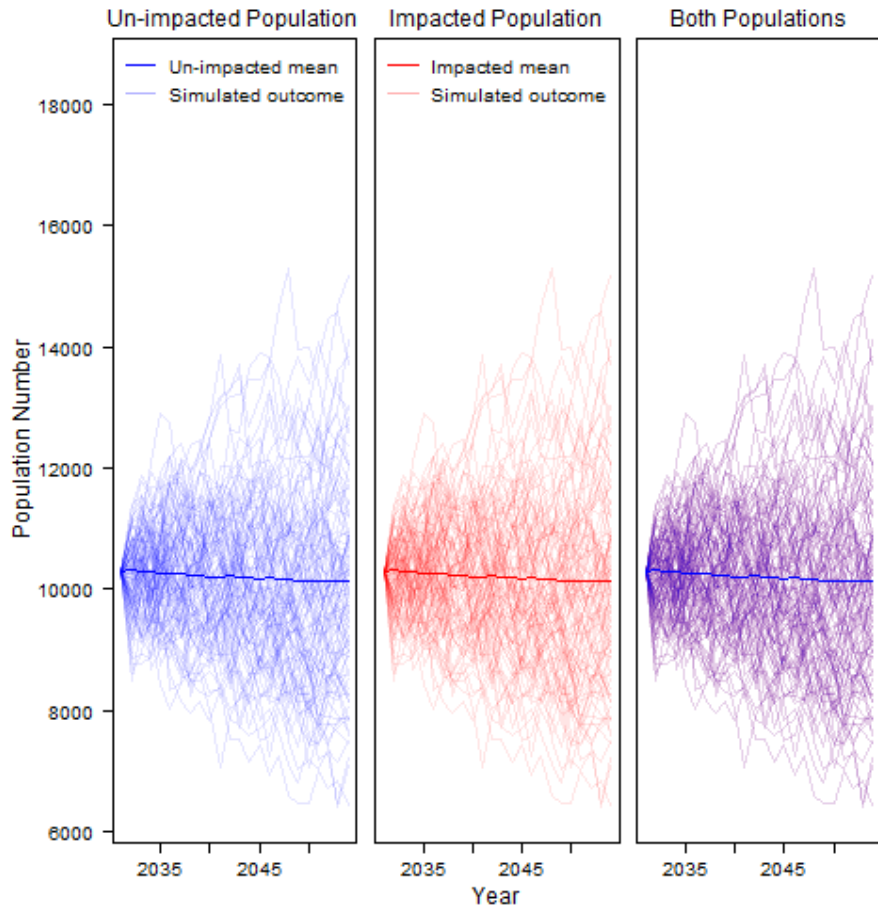


Figure 10.18: Simulated Minke Whale Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation (Maximum Spatial Scenario)

10.10.78 The extent of the impact is anticipated to be over a limited scale or geographic extent (in terms of proportion of the reference population), which is supported by the low percentage of the population estimated to be affected. The long-term population modelling also predicts no population impact from the assessed impact piling, although both the un-impacted and impacted populations show a gradual decline over time. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, there would be no population-level consequences of disturbance. The magnitude of impact for minke whale is therefore low.

10.10.79 Fin whale has been recorded close to the Local Marine Mammal Study Area within the Moray Firth, Aberdeen coast, and the Firths of Forth and Tay; however, there are no density estimates available to enable a quantitative assessment. Fin whale is in the same hearing group as minke whale and therefore the magnitude of impact is anticipated to be the same as or lower than for minke whale. The magnitude of impact for fin whale is therefore low.

10.10.80 Although there have been increased sightings of humpback whale in Scotland (see Paragraph 10.6.10) there are no density estimates available to enable a quantitative assessment. Humpback whale is in the same hearing group as minke whale and therefore the magnitude of impact is anticipated to be the same as or lower than for minke whale. The magnitude of impact for humpback whale is therefore low.

Grey Seal

10.10.81 For the single piling scenario, up to 1,235 individuals (mean) (based upon the density surface estimates from Carter *et al.* (2025)) are estimated to be at risk of disturbance (Table 10.50). This equates to 2.36% of the reference population (detailed in Table 10.15).

10.10.82 For the concurrent piling scenario (Figure 10.19), up to 1,772 individuals (mean) (based upon the density surface estimates from Carter *et al.* (2022)) are estimated to be at risk of disturbance Table 10.50). This equates to 3.38% of the reference population (detailed in Table 10.15).

10.10.83 Figure 10.19 illustrates that there is some overlap of the 130 to 135 dB SEL_{ss} subsea noise contours (mild disturbance) for both the single and concurrent scenario with the Berwickshire and North Northumberland Coast SAC and Isle of May SAC, designated for grey seal, as well as offshore areas surrounding designated Haul-Out sites for seals (see Volume 3 Technical Appendix 10.2: Marine Mammal Technical Report). Therefore, due to the impact of piling noise there may be mild disturbance to grey seal within the Berwickshire and North Northumberland Coast SAC and Isle of May SAC and waters surrounding designated Haul-Out sites on the east coast of Scotland.

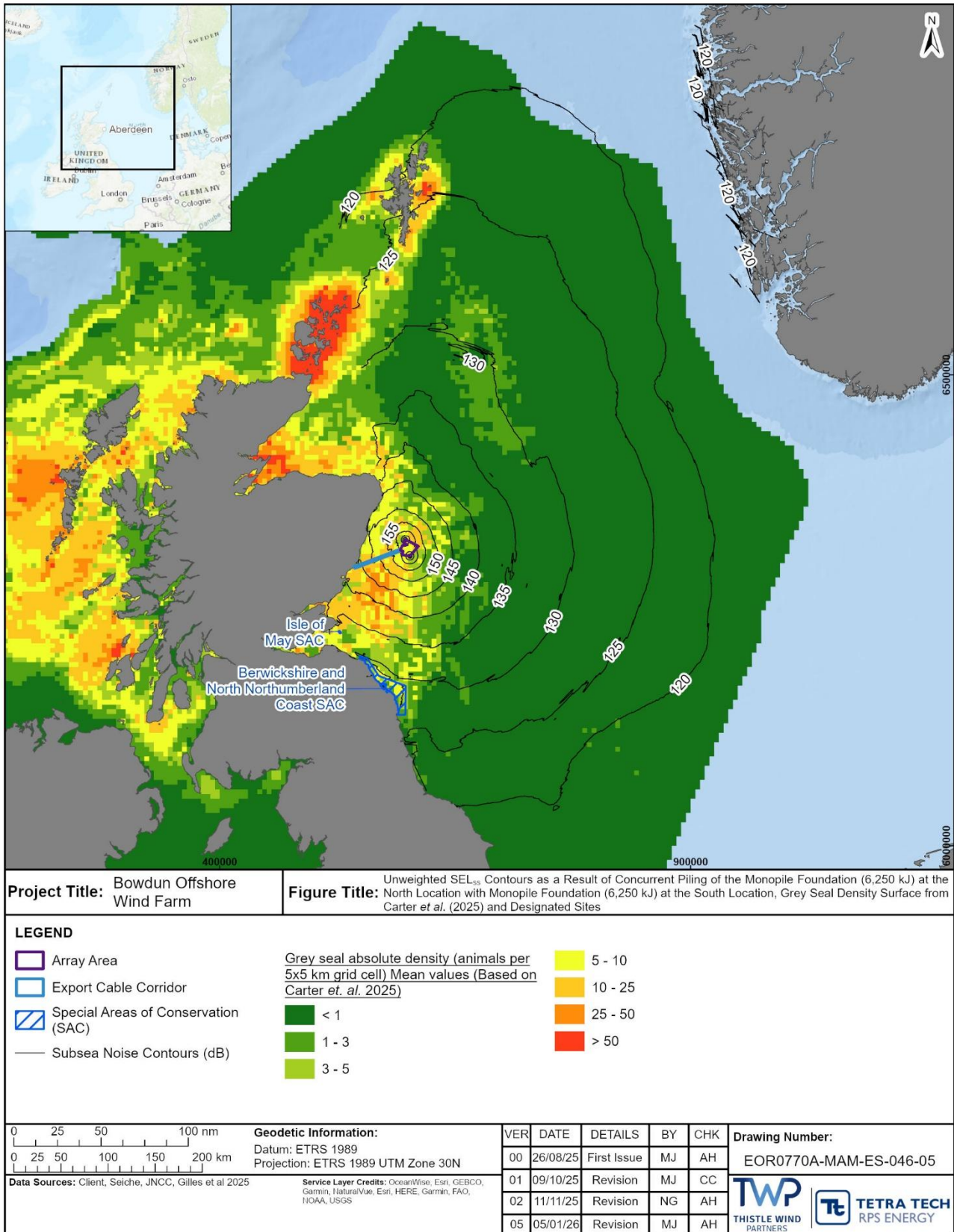


Figure 10.19: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Grey Seal Density and Designated Sites

- 10.10.84 Population modelling was run for grey seal, and graphs comparing the un-impacted and impacted populations for each scenario are presented in Figure 10.20 to Figure 10.21.
- 10.10.85 Results of the iPCoD modelling for grey seal against the reference population for the single installation scenario and concurrent scenario (Figure 10.20 and Figure 10.21) showed that the median ratio of the impacted population to the un-impacted population at five, ten and 25 years was one, which indicates there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.20 and Figure 10.21. The population modelling suggests that there is no predicted impact to the population from the construction of the Proposed Development over the 25-year modelled period from the single monopile foundation installation scenario or the concurrent scenario.

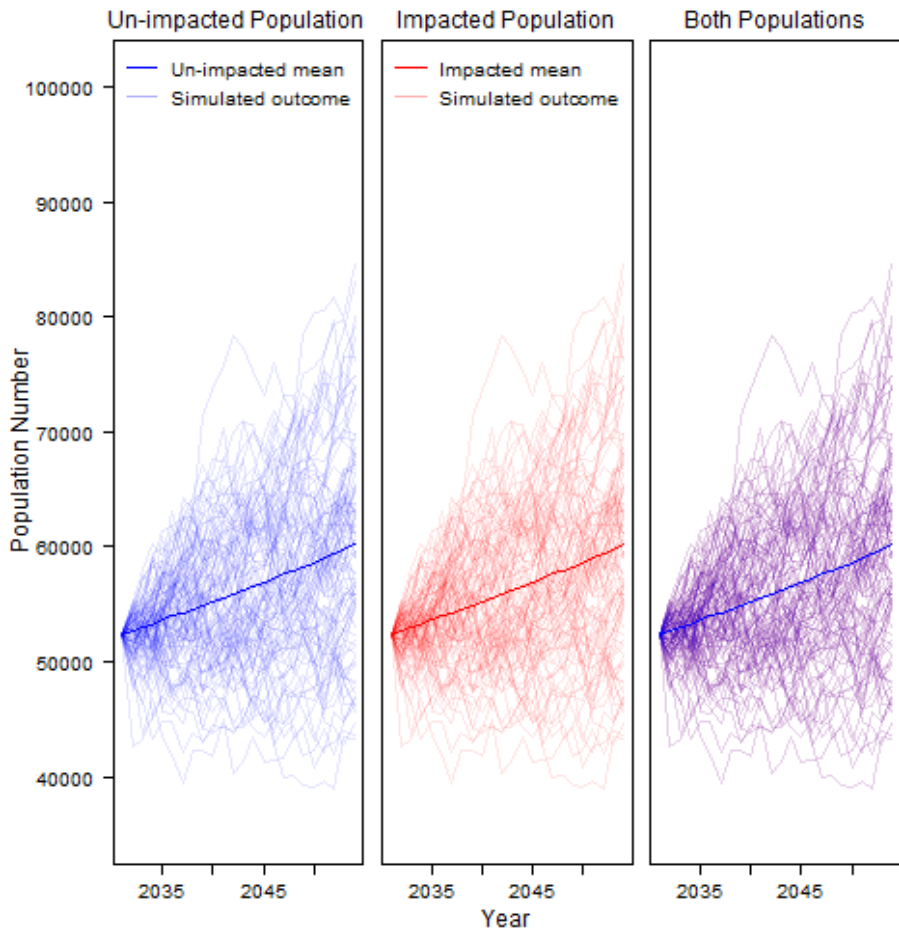


Figure 10.20: Simulated Grey Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Floating and OSP Installation (Maximum Temporal Scenario)

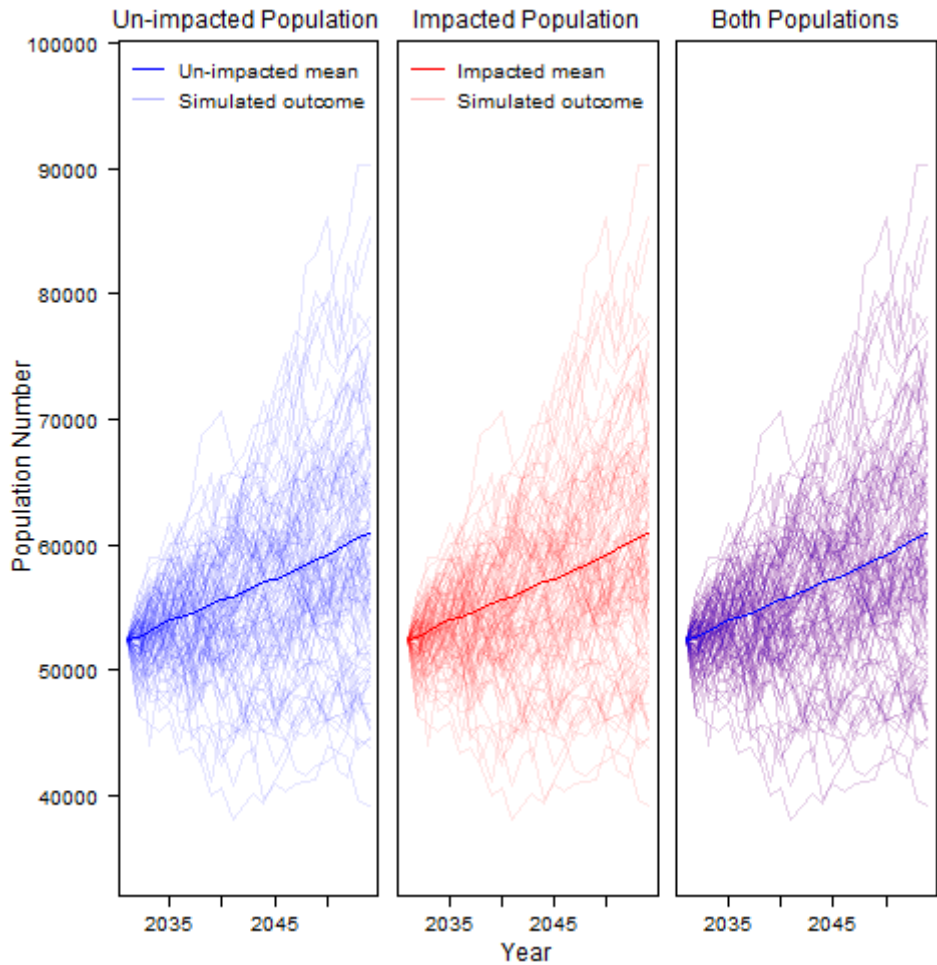


Figure 10.21: Simulated Grey Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Floating and OSP Installation (Maximum Concurrent Scenario)

10.10.86 The extent of the impact is anticipated to be over a limited to medium scale or geographic extent (in terms of proportion of the reference population), which is informed by the percentage of the population estimated to be affected. The long-term population modelling predicts no population impact from the assessed impact piling, and both the un-impacted and impacted populations show a gradual increase over time. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, there would be no population-level consequences of disturbance. The magnitude of impact for grey seal is therefore medium on a precautionary basis due to the predicted percentage of the reference population at risk of disturbance.

Harbour Seal

10.10.87 For the single piling scenario, up to eight individuals (mean; rounded to whole animal) (based upon the density surface estimates from Carter *et al.* (2025)) are estimated to be at risk of disturbance (Table 10.50). This equates to the mean of 0.61% of the reference population (detailed in Table 10.15)

- 10.10.88 For the concurrent piling scenario (Figure 10.19), up to nine individuals (mean) (based upon the density surface estimates from Carter *et al.* (2025)) are estimated to be at risk of disturbance (Table 10.47). This equates to the mean of 0.68% of the reference population (detailed in Table 10.15).
- 10.10.89 Figure 10.22 illustrates that there is some overlap of the 135 dB SEL_{ss} subsea noise contours (mild disturbance) for both the single and concurrent scenario with the Firth of Tay and Eden Estuary SAC, designated for harbour seal, as well as offshore areas surrounding designated Haul-Out sites for seals (see Volume 3, Technical Appendix 10.3: Marine Mammal Technical Report). However, as for bottlenose dolphin (see Paragraph 10.10.63), due the landmass to the north-east of the Local Marine Mammal Study Area will block some of the sound transmission, and therefore it is uncertain which subsea noise contour would overlap with the Dornoch Firth and Morrich More SAC. It is assumed that the MDS would be an overlap of the 130 to 135 dB SEL_{ss} subsea noise contours for both the single and concurrent scenario (Figure 10.22). The coastal area where harbour seal is found within the Dornoch Firth and Morrich More SAC lies 159.4 km from the Proposed Development and at this distance the received level from piling will have likely lost much of the impulsive characteristics. Therefore, due to the impact of piling noise there may be mild disturbance to harbour seal within the Firth of Tay and Eden Estuary SAC and Dornoch Firth and Morrich More SAC and waters surrounding designated Haul-Out sites on the east coast of Scotland.

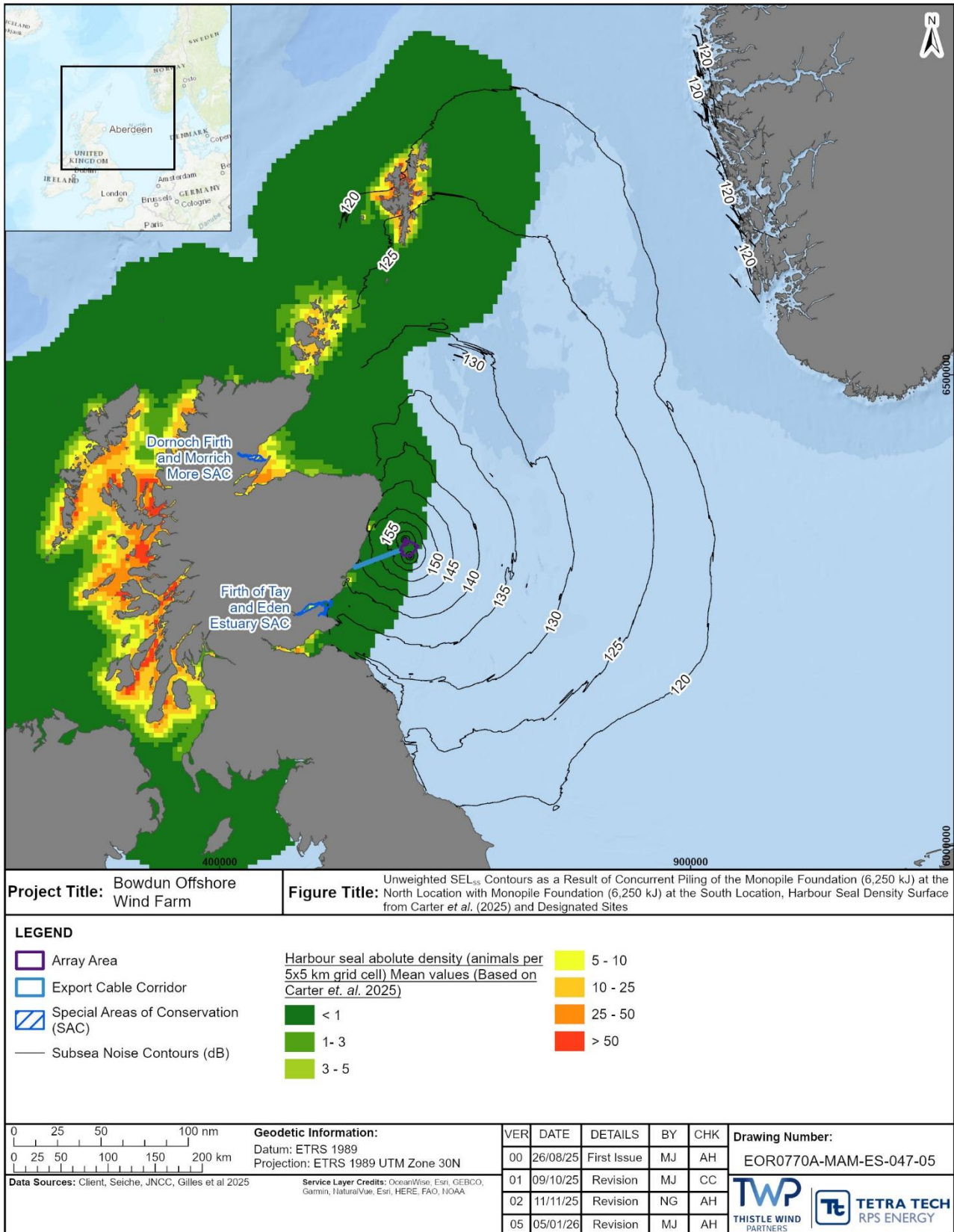


Figure 10.22: Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Harbour Seal Density and Designated Sites

- 10.10.90 Population modelling was run for harbour seal, and graphs comparing the un-impacted and impacted populations for each scenario are presented in Figure 10.20 to Figure 10.21.
- 10.10.91 Results of the iPCoD modelling for harbour seal against the reference population for the single floating and OSP installation scenario and concurrent scenario (Figure 10.23 and Figure 10.24) showed that the median ratio of the impacted population to the un-impacted population at five, ten and 25 years was one, which indicates there is no significant difference between the population trajectories for an un-impacted population and the impacted population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report). At five, ten and 25 years, there was no difference between the impacted population and un-impacted population. Small changes in the impacted population size over time are similar to those predicted for an un-impacted population, as can be seen in Figure 10.20 and Figure 10.24. The population modelling suggests that there is no predicted impact to the population from the construction of the Proposed Development over the 25year modelled period from the single monopile foundation installation scenario and concurrent scenario.

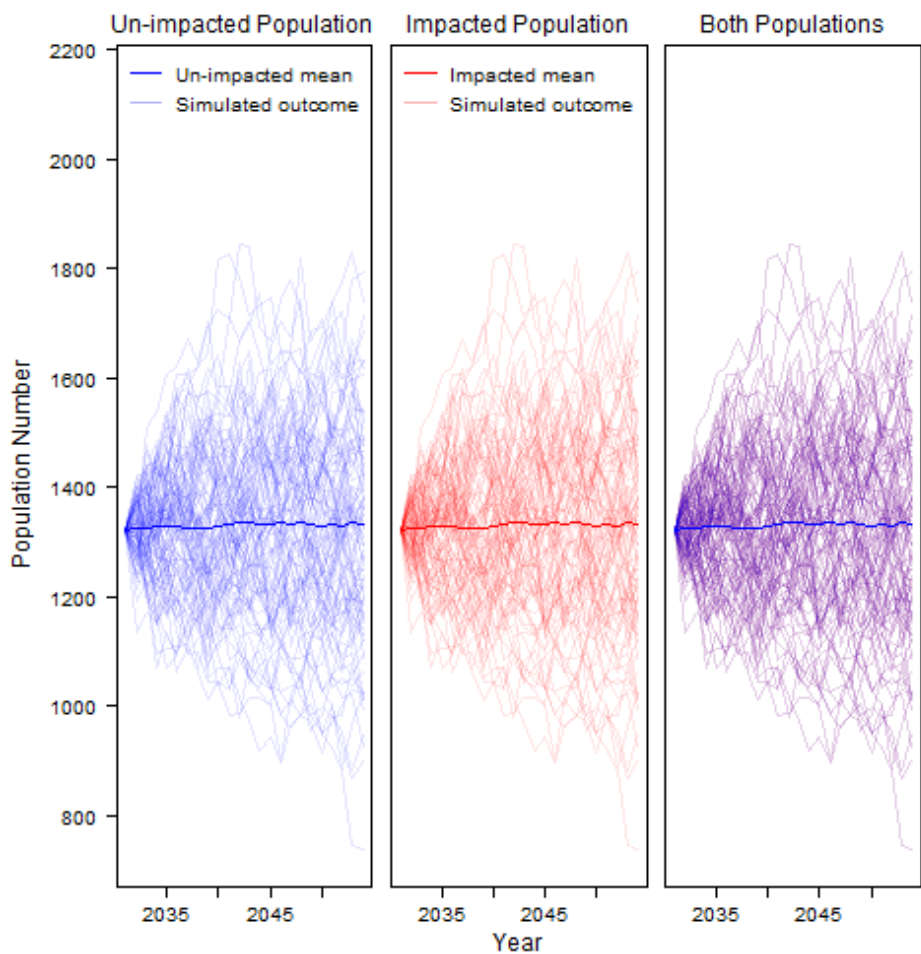


Figure 10.23: Simulated Harbour Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Single Piling and OSP Installation

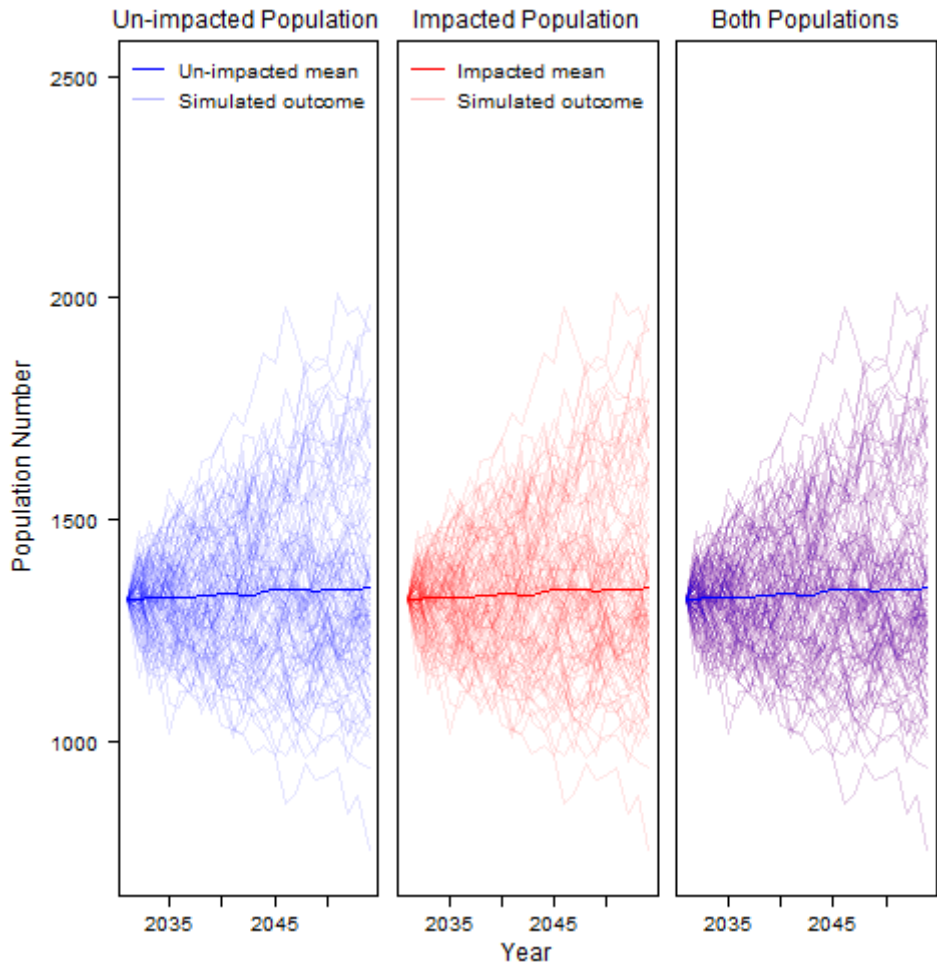


Figure 10.24: Simulated Harbour Seal Population Sizes Un-Impacted (Baseline) and the Impacted Populations for Concurrent Piling and OSP Installation

10.10.92 The extent of the impact is anticipated to be over a limited scale or geographic extent (in terms of proportion of the reference population), which is supported by the low percentage of the population estimated to be affected. The long-term population modelling also predicts no population impact from the assessed impact piling, and whilst both the un-impacted and impacted populations show a gradual decrease over time, there was no difference between the modelled un-impacted and impacted populations. The duration is anticipated to be short-term. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), however, there would be no population-level consequences of disturbance. The magnitude of impact for harbour seal is therefore low.

Cetacean Sensitivity

Harbour Porpoise

10.10.93 As a small cetacean species, harbour porpoise is vulnerable to heat loss through radiation and conduction. They have a high metabolic requirement, in the wild, porpoises forage almost continuously day and night to achieve their required calorific intake (Wisniewska *et al.*, 2016) meaning they may be vulnerable to starvation if foraging is interrupted.

- 10.10.94 It is well documented that there is variance in behavioural responses to increased underwater noise and it is context specific. Factors such as the activity state of the receiving animal, the nature and novelty of the noise (i.e. previous exposure history), and the spatial relation between noise source and receiving animal are important in determining the likelihood of a behavioural response and therefore their sensitivity (Ellison *et al.*, 2012). Empirical evidence from monitoring at OWFs during construction suggests that pile driving is unlikely to lead to 100% avoidance of all individuals exposed, and that there will be a proportional decrease in avoidance at greater distances from the pile driving source (Brandt *et al.*, 2011). Graham *et al.* (2019) demonstrated this dose-response at Horns Rev OWF, where 100% avoidance occurred in harbour porpoises at up to 4.8 km from the piles, whilst at greater distances (10 km plus) the proportion of animals displaced reduced to <50%.
- 10.10.95 More recently Benhemma-Le Gall *et al.* (2021) studied responses of harbour porpoise to piling at the Beatrice OWF and suggested that harbour porpoise may adapt to increased noise disturbance over the course of the piling phase, thereby showing a degree of tolerance and behavioural adaptation. Graham *et al.* (2019) also demonstrated that the probability of occurrence of harbour porpoise (measured as porpoise positive minutes) increased exponentially moving further away from the noise source. Similarly, a study of seven OWFs constructed in the German Bight (the south-eastern bight of the North Sea) demonstrated that detections of harbour porpoise declined several hours before the start of piling within the vicinity (up to 2 km) of the construction site and were reduced for about one to two hours post piling (Brandt *et al.*, 2018). At the maximum effect distances (from 17 km out to approximately 33 km) avoidance only occurred during the hours of piling.
- 10.10.96 Although harbour porpoise may be able to avoid the disturbed area and forage elsewhere, there may be a potential effect on reproductive success of some individuals. As aforementioned, it is anticipated that there would be some adaptability to the elevated noise levels from piling and therefore survival rates are not likely to be affected. Benhemma-Le Gall *et al.* (2021) demonstrated that harbour porpoise were not completely displaced from the area, though spent less time buzzing, whilst increased clicks and foraging buzzes detected further from the piling location suggested animals may compensate for the lost foraging opportunities. The assessment is highly conservative due to uncertainties associated with the effects of behavioural disturbance on vital rates of harbour porpoise, as it assumes the same level of sensitivity for both strong and mild disturbance, noting that for the latter the sensitivity is likely to be lower.
- 10.10.97 VHF cetaceans (harbour porpoise) are deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the harbour porpoise is conservatively considered to be medium.

Bottlenose Dolphin, White-Beaked Dolphin and Risso's Dolphin

- 10.10.98 Limited information is available regarding the specific sensitivities of bottlenose dolphin, white-beaked dolphin and Risso's dolphin to disturbance from piling noise as most studies have concentrated on harbour porpoise. A study of the response of bottlenose dolphin to piling noise during harbour construction works at the Nigg Energy Park in the Cromarty Firth (north-east Scotland) found that there was a measurable (albeit weak) response to impact and vibration piling with animals reducing the amount of time they spent in the vicinity of the construction works (Graham *et al.*, 2017). Another study investigating dolphin detections in the Moray Firth during impact piling at the Moray East and Beatrice OWFs found surprising results at small temporal scales with an increase in dolphin detections on the southern Moray Firth coast on days with impulsive noise compared to days without (Fernandez-Betelu *et al.*, 2021). Predicted maximum received levels in coastal areas were 128 dB re. 1 $\mu\text{Pa}^2\text{s}$ and 141 dB re. 1 $\mu\text{Pa}^2\text{s}$ during piling at Beatrice and Moray OWFs, respectively (Fernandez-Betelu *et al.*, 2021). The authors of this study warn caution regards these results as increased click changes do not necessarily equate to larger groups sizes but may result from modification in behaviour (e.g. an increase in vocalisations during piling). The results, however, do suggest that impulsive noise generated during piling at the OWFs did not cause any displacement of bottlenose dolphins from their population range. Notably, the received levels during piling at Moray OWF are higher than those predicted for the outer contours (130 dB re 1 $\mu\text{Pa}^2\text{s}$ and 135 dB re 1 $\mu\text{Pa}^2\text{s}$) that overlap with the Coastal East Scotland MU during piling at the Proposed Development, suggesting that minor disturbance at these lower noise levels is unlikely to lead to displacement effects.
- 10.10.99 HF cetaceans (bottlenose dolphin, white-beaked dolphin and Risso's dolphin) are not thought to be as vulnerable to disturbance as harbour porpoise; for example with larger body sizes and lower metabolic rates, the necessity to forage frequently is lower in comparison (Noren and Rosen, 2023).
- 10.10.100 The Southall (2021) severity spectrum applies across all marine mammals and therefore it is expected that, as described for harbour porpoise, strong disturbance in the near field could result in displacement whilst mild disturbance over greater ranges would result in other, less severe behavioural responses.
- 10.10.101 HF cetaceans may be able to avoid the disturbed area and whilst there may be some impacts on reproduction in closer proximity to the source (i.e. within the area of 'strong disturbance'), these are unlikely to impact on survival rates as some tolerance is expected to build up over the course of the piling. It is anticipated that animals would return to previous activities once the impact had ceased.
- 10.10.102 The HF cetaceans (bottlenose dolphin, white-beaked dolphin and Risso's dolphin) are deemed to have some adaptability (avoidance behaviour) and tolerance to disturbance, and high recoverability. The sensitivity of the HF cetaceans is therefore, considered to be low.

Minke Whale, Fin Whale and Humpback Whale

- 10.10.103 There are limited studies that consider minke whale, fin whale or humpback whale responses to underwater noise. McGarry *et al.* (2017) found aversive responses to ADD playbacks in minke whale and Christiansen *et al.* (2013a) found that minke whale may alter their diving behaviour in response to whale-watching vessels. Minke whale are able to adopt a low energy feeding strategy by exploiting prey herded by other species, however, their reliance on sandeel as the primary energy resource (up to 70% of its diet in Scotland (Tetley *et al.*, 2008)) means that disturbance from areas that are important for sandeel could have implications on the health and survival of disturbed individuals. Volume 2, Chapter 9: Fish and Shellfish Ecology suggests that there are high intensity spawning and low intensity nursery grounds for sandeel overlapping with the Site Boundary. Therefore, in line with a study by Christiansen *et al.* (2013b) in Iceland displacement of minke whale could lead to reduced foraging for disturbed individuals. However, a subsequent study in the same study area (Christiansen and Lusseau, 2015) found no significant long-term effects of disturbance from whale-watching on vital rates since whales moved into disturbed areas when sandeel numbers were lower across their wider foraging area.
- 10.10.104 Minke whale, fin whale and humpback whale are expected to be able to tolerate short-term displacement due to their large size and capacity for energy storage, and therefore short-term displacement is unlikely to affect vital rates (Christiansen and Lusseau, 2015).
- 10.10.105 LF cetaceans are deemed to have some adaptability (avoidance behaviour) and tolerance to disturbance, and high recoverability. The sensitivity of the LF cetaceans is therefore, considered to be low.

Pinniped Sensitivity

- 10.10.106 There are limited studies that consider pinniped sensitivity to disturbance. However, this has been reviewed and discussed during the expert elicitation workshops conducted for the iPCoD model (Booth *et al.*, 2019) where parameters were assigned for use within the model to reflect the likely effect of disturbance. The initial elicitation carried out in 2013 assumed that one day of disturbance results in a 24 hour period with no foraging. In 2019, this was considered to be over precautionary as the true effects of disturbance were likely to be much more short lived (e.g. Russell *et al.*, 2016). Although there are likely to be alternative foraging sites for both harbour seal and grey seal, avoidance behaviour during piling could either prevent seals from travelling to forage from haul-out sites or force seals to travel greater distances than is usual during periods of piling (Booth *et al.*, 2019; Russell *et al.*, 2014; Russell *et al.*, 2016). However, in general, both seal species are considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores (Booth *et al.*, 2019).

- 10.10.107 Hastie *et al.* (2021) measured the relative influence of perceived risk of a sound (silence, pile driving, and a tidal turbine) and prey patch quality (low density versus high density), in grey seal in an experimental pool environment. The study found foraging success was highest under silence, but under tidal turbine and pile driving treatments success was similar at the high density prey patch but significantly reduced under the low density prey patch. Therefore, avoidance rates were dependent on the quality of the prey patch as well as the perceived risk from the anthropogenic sound and therefore it can be anticipated such decisions are consistent with a risk/profit balancing approach.
- 10.10.108 Seal behaviour during OWF installation has been studied based on empirical data (Russell *et al.*, 2016). Movements of tagged harbour seal during piling at the Lincs OWF in the Greater Wash showed significant avoidance of the OWF by harbour seal (Russell *et al.*, 2016). Within this study, seal abundance significantly reduced during the piling activity up to a distance of 25 km, with a 19% to 23% decrease in usage within this range. Nevertheless, displacement was limited to pile driving activity only, and harbour seal returned rapidly to baseline levels of activity within two hours of cessation of the piling (Russell *et al.*, 2016). Diverse reactions of tracked grey seal to pile driving during construction of the Luchterduinen and Gemini wind farms was reported in Aarts *et al.*, 2018. Reactions ranged from altered surfacing and diving behaviour, changes in swimming direction, or coming to a halt. In some cases, however, no apparent changes in diving behaviour or movement were observed (Aarts *et al.*, 2018). Similar to the conclusions drawn by Hastie *et al.* (2021), the study at the Luchterduinen and Gemini wind farms indicated animals were balancing risk with profit.
- 10.10.109 Pinnipeds may also be vulnerable to disturbance during sensitive periods, e.g. during and prior to reproduction. For example, the lactation period for grey seal lasts around 17 days (Sparling *et al.*, 2006), with females remaining mostly on shore, fasting. Grey seal females do not forage often during lactation, therefore, it is expected that they may exhibit some tolerance to disturbance as they would not spend as much time at sea, where they can be affected by underwater sound.
- 10.10.110 Both seal species are deemed to have some adaptability (ability to avoid or adapt behaviour) and some tolerance to disturbance, with high recoverability. The sensitivity of grey seal and harbour seal is therefore, considered to be low.

Significance of the Effect

- 10.10.111 Overall, for harbour porpoise, the magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be medium. The effect will therefore be of negligible or minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.
- 10.10.112 Overall, for bottlenose dolphin, Risso's dolphin, minke whale, fin whale, humpback whale and harbour seal, the magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be low. The effect will therefore be of negligible or minor significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

10.10.113 Overall, for white-beaked dolphin and grey seal, the magnitude of the impact is deemed to be medium, and the sensitivity of the receptor is considered to be low. The effect will therefore be of negligible or minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.10.114 No Additional Mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

IMPACT 2: INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING UXO CLEARANCE

Construction Phase

Magnitude of Impact

10.10.115 Clearance of UXO may be required to ensure that all element of seabed interaction can be conducted safely. This will include all seabed preparation activities, installation of foundations and cables.

10.10.116 The precise details and locations of potential UXOs is unknown at the time of writing. Therefore, subsea modelling was undertaken for a range of charge configurations as set out in Table 10.52 below (see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for full detail).

10.10.117 It is anticipated that up to 40 UXOs within the Proposed Development may require clearance. The maximum size is 720 kg NEQ (Table 10.19). Although the clearance activities will be tide and weather dependent, the aim will be to enable clearance of two UXO targets within 24 hours.

Table 10.52: Details of UXO and their Relevant Charge Sizes Employed for Modelling

Charge Size (kg NEQ)	Notes/Assumptions
Low Order and Low-Yield Donor Charge Configurations	
0.08 kg	Estimated size of donor charge used for low order technique.
0.5 kg	Estimated size of clearing shot to neutralise any residual explosive material.
Potential UXOs (High Order Disposal)	
227 kg	Realistic maximum design UXO charge weight, based on British WW2 mine Mk XIV.
720 kg	Estimated UXO size that is anticipated to be encountered, based on a 1,000 kg German WW2 mine BM1000.

- 10.10.118 Acoustic modelling for UXO clearance was conducted following the approach outlined in Soloway and Dahl (2014). The modelled estimates are conservative, because the charge is assumed to be freely positioned in mid-water, unlike a UXO which could be resting on the seabed, or completely or partially buried thus impeding noise propagation. Further, the explosive material is likely to have deteriorated over time, making estimated maximum sound levels probable overestimations of actual sound levels.
- 10.10.119 Frequency-dependent weighting functions were applied to facilitate comparison with marine mammal hearing weighted thresholds. As per Robinson *et al.* (2020), low order deflagration yields a considerably lower amplitude of peak sound pressure compared to high order detonations. The study concluded that peak sound pressure during deflagration is due only to the size of the shaped charge used to initiate deflagration.
- 10.10.120 Potential impacts of subsea noise resulting from UXO clearance on marine mammals could include mortality, physical injury or auditory injury depending on the individuals' proximity to the detonation. The duration of impact (elevated noise) for each UXO detonation is very short (seconds) therefore behavioural effects are considered to be negligible in this context. As such, TTS represents temporary auditory impairment but can be also considered as a threshold for the onset of a strong behavioural disturbance (or a moving away response).
- 10.10.121 A detailed subsea noise modelling assessment was carried out to investigate the potential for auditory injury and TTS to occur, using the latest assessment criteria (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). A project-specific outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) has been developed to mitigate the potential for injury.
- 10.10.122 Whilst the clearance of UXO has historically been undertaken using a high order detonation, in line with the UK Government (2025) joint interim position statement, the Applicant commits to the use of low order clearance techniques as the default (Table 10.19). However, to ensure a precautionary approach, the assessment of significance for AUD INJ and behavioural disturbance (using TTS onset as a proxy) is presented for both the high order and low order scenarios.

Auditory Injury

- 10.10.123 The assessment of auditory injury has used the impulsive threshold criteria, but as highlighted in Section 10.8, impulsive sound is likely to undergo transition to non-impulsive sound with distance from the sound source. Therefore, sound is unlikely to remain impulsive in character once it has propagated more than a few kilometres (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). The precise range at which this transition occurs is currently unknown (ORJIP, 2024). Hastie *et al.* (2019) suggested that some measures of impulsiveness change markedly within approximately 10 km of the source (the study focused on seismic surveys and piling, but this is also likely to be the case with UXO clearance). As such, caution should be used when interpreting any results with predicted injury ranges in the order of tens of kilometres as

the auditory injury ranges are likely to be significantly lower than those predicted.

10.10.124 Auditory injury ranges for low and high order clearance are presented in Table 10.53. For those species where quantitative assessment is possible, the number of animals predicted to be at risk of auditory injury due to low and high order clearance is presented in Table 10.54.

Table 10.53: Maximum Potential AUD INJ Ranges for Low order Clearance and High order Clearance (N/E = Threshold Not Exceeded) (NMFS, 2024)

Species/Group	Metric	Threshold	Range (m)			
			Low Order Donor Charge (0.08 kg)	Low Order Clearing Shot (0.5 kg)	High Order Realistic (227 kg)	High Order (720 kg)
LF	Peak SPL	222 dB re 1µPa	90	165	1,265	1,855
	SEL _{cum}	183 dB re 1µPa ² s	51	125	2,415	4,120
HF	Peak SPL	230 dB re 1µPa	40	73	560	825
	SEL _{cum}	193 dB re 1µPa ² s	N/E	N/E	79	138
VHF	Peak SPL	202 dB re 1µPa	685	1,265	9,685	14,230
	SEL _{cum}	159 dB re 1µPa ² s	175	395	2,935	3,780
PCW	Peak SPL	223 dB re 1µPa	81	149	1,140	1,675
	SEL _{cum}	183 dB re 1µPa ² s	16	39	740	1,245

Table 10.54: Maximum Potential Number of Animals with the Potential to Experience Auditory Injury Due to Low order Clearance and High order Clearance (N/E = Threshold Not Exceeded)

Metric	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Low Order Donor Charge (0.08kg)						
Peak SPL	<1	<1	<1	<1	<1	<1
SEL _{cum}	<1	N/A	N/A	<1	<1	<1
Low Order Clearing Shot (0.5 kg)						
Peak SPL	4	<1	<1	<1	<1	<1
SEL _{cum}	<1	N/A	N/A	<1	<1	<1
High Order Realistic (227 kg)						
Peak SPL	188	<1	<1	<1	3	<1
SEL _{cum}	18	<1	<1	<1	<1	<1
High Order (720 kg)						

Metric	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Peak SPL	404	<1	<1	<1	5	<1
SEL _{cum}	29	<1	<1	2	3	<1

- 10.10.125 A high order UXO clearance of the maximum 720 kg NEQ yielded the largest auditory injury ranges for all species, with the greatest injury range (14,230 m) seen for harbour porpoise (peak SPL) (Table 10.53). The auditory injury range predicted for a high order UXO detonation of the realistic maximum case (227 kg NEQ) is reduced to 9,685 m for harbour porpoise (peak SPL). Conservatively, the number of harbour porpoises that could be potentially injured, based on the density of 0.635 animals per km² (Gilles *et al.*, 2025) was estimated as 404 animals for a 720 kg NEQ UXO high order clearance (peak SPL, equating to 0.25% of the UK portion of the North Sea MU. Predicted numbers are smaller for the realistic maximum case of UXO clearance (227 kg NEQ) with up to 188 animals at risk of auditory injury (peak SPL, equating to 0.12% of the UK portion of the North Sea MU). For low order donor charge (0.08 kg NEQ) and low order clearing shot (0.5 kg NEQ), the auditory injury ranges of 685 m and 1,265 m were predicted (Table 10.53), resulting in a maximum of four harbour porpoises at risk (Table 10.54).
- 10.10.126 The subsea noise assessment found that the maximum auditory injury range estimated for HF cetaceans (bottlenose dolphin, white-beaked dolphin and Risso's dolphin) using the peak SPL metric was 825 m for the high order detonation of 720 kg NEQ, reduced to 560 m for the realistic maximum case (227 kg NEQ) (Table 10.53). Given relatively low densities of species within the Local Marine Mammal Study Area, the high order detonation of 720 kg and 227 kg could result in the risk of injury for no more than one individual for both bottlenose dolphin and white-beaked dolphin (Table 10.54). The number of individuals predicted to be at risk, relates to very small proportions of the relevant UK portion of the MUs (i.e. less than 0.01%). For low order clearance donor charge (0.08 kg NEQ) and clearing shot (0.5 kg NEQ), the injury ranges were considerably lower with a maximum of 40 m and 73 m respectively (Table 10.53), and there would be no more than one animal at risk of auditory injury within these ranges (Table 10.54).
- 10.10.127 The maximum auditory injury range for LF cetaceans (minke whale, fin whale and humpback whale) was estimated at 4,120 m (SEL_{cum}) for the high order detonation of 720 kg NEQ, reduced to 2,415 m for the realistic maximum case of 227 kg NEQ (Table 10.53). The maximum auditory injury range using peak SPL was 1,855 m for the high order detonation of 720 kg NEQ, reduced to 1,265 m for the realistic maximum case 227 kg NEQ (Table 10.53). The number of minke whale that could be at risk of auditory injury was estimated at less than one individual for the high order detonation of 720 kg NEQ using the peak SPL and up to two individuals using the SEL_{cum} metric. This equates to a maximum of

0.02% of the UK portion of the CGNS MU (Table 10.36). For low order techniques, the maximum range predicted was up to 165 m (peak SPL) (0.08 kg NEQ) (Table 10.53) and again there would be less than one animal potentially injured within this range (Table 10.54).

- 10.10.128 The maximum auditory injury range estimated for seals was 1,675 m using the peak SPL metric, for the high order detonation of 720 kg NEQ, reduced to 1,140m for the realistic maximum case of 227 kg NEQ (Table 10.53). The number of individuals that could be at risk of auditory injury was, for harbour seal, less than one individual for the high order detonation of 720 kg NEQ (Table 10.54), based on average densities within the Local Marine Mammal Study Area from Carter *et al.* (2025). This equates to 0.01% of the East Scotland and the Moray Firth SMUs. For grey seal (based on the average densities within the Local Marine Mammal Study Area from Carter *et al.* 2022), the number of individuals that could be at risk of auditory injury was estimated at up to five animals for the high order detonation of 720 kg NEQ (peak SPL) (Table 10.54), which equates to 0.01% of the East Scotland, North Coast and Orkney and Moray Firth SMUs. The estimate of the number of individuals at risk for the realistic maximum case of 227 kg NEQ (peak SPL) was no more than three individuals. For low order clearance donor charge (0.08 kg NEQ) and clearance shot (0.5 kg NEQ), the injury ranges were considerably lower with a maximum of 81 m and 149 m (peak SPL), respectively (Table 10.53) resulting in less than one animal at risk within these ranges (Table 10.54).
- 10.10.129 The closest protected site designated for seals is the Firth of Tay and Eden Estuary SAC (harbour seal) at 40.4 km from the Proposed Development. The maximum modelled auditory injury range for seals is 1,675 m. Consideration of the 50 km connectivity buffer means that seals connected to the SAC could be at risk of auditory injury.
- 10.10.130 As part of Embedded Mitigation adopted for the Proposed Development (Table 10.30), an outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) has been developed for the purpose of mitigating the risk of auditory injury to marine mammals from potential UXO clearance activities at the Proposed Development. The measures included within the outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) (Table 10.30) are in line with JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2025a).
- 10.10.131 Low order techniques will be applied as the default methodology for clearance of UXO. However, current guidance is to consider mitigation needs based on the maximum design high order scenario.
- 10.10.132 Given the potential for auditory injury from high order detonations for several marine mammal receptors (harbour porpoise, minke whale, fin whale, humpback whale, harbour seal and grey seal) is at a greater range than can be mitigated by monitoring the 1 km zone an ADD as part of the Embedded Mitigation measures will be deployed to deter marine mammals to a greater distance before any detonation.

- 10.10.133 This assessment has presented the auditory injury range based on high order detonation of a 720 kg NEQ UXO (Table 10.53). At the time of writing, the actual number and size of the UXOs within the Proposed Development are unknown and therefore, the example ADD mitigation has been designed for a range of UXO munitions sizes so that the most appropriate approach can be applied to balance the risk of injury from UXO detonation with any additional noise introduced into the marine environment as deterrent measures.
- 10.10.134 The duration of the application of an ADD prior to UXO detonation is informed by marine mammal swim speeds (Table 10.28). The assumption being that individual animals will continue to flee. An ADD will be activated within the 60 minute pre-detonation search, provided no marine mammals have been observed within the mitigation zone for a minimum of 20 minutes. The ADD activation time, has been based on the risk to harbour porpoise as this is the species with the largest predicted auditory injury ranges.

Table 10.55: UXO Clearance Application of ADD Mitigation

Species/ Group	Metric	Range (m)		Activation Duration of the ADD		
		Low Order Clearing shot (0.5 kg)	High Order (720 kg)	Low Order (0.5 kg)	High Order (720 kg)	Using Max Activation Time of 60 mins – Deterrence Range (m)
LF	Peak SPL	165 m	1,855 m	72 seconds	13 minutes	NA
HF	Peak SPL	73 m	825 m	48 seconds	9 minutes	NA
VHF	Peak SPL	1,265 m	14,230 m	14 minutes	2.5 hours	5,400 m (residual 8,830 m)
PCW	Peak SPL	149 m	1,675 m	83 seconds	16 minutes	NA

- 10.10.135 The indicative analysis presented in (Table 10.50; Table 10.55) suggests that for UXO sizes of up to 720 kg, the pre-detonation search and use of 60 minutes of ADD will be sufficient to reduce the risk of auditory injury to bottlenose dolphin, white-beaked dolphin, Risso’s dolphin, minke whale, fin whale, humpback whale, harbour seal and grey seal to negligible magnitude.
- 10.10.136 However, it has been estimated that harbour porpoises could be at risk of auditory injury at distances that cannot be fully mitigated by application of ADD within the maximum activation time of 60 minutes. (see Table 10.55). The maximum deterrence range has been assessed as 5,400 m; however, the auditory injury range for this species has been modelled at 14,230 m (720 kg), resulting in a risk over a residual 8,830 m.

- 10.10.137 It is important to note that the duration of activation may not be the key parameter driving the range of displacement. Thompson *et al.* (2020) found that the responses of harbour porpoises to an ADD that was activated for 15 minutes, was in the same order of magnitude as the displacement as a result from impact piling. Within the three hours following the ADD activation, analysis of click detectors indicated that there was a 50% probability of response within 21.7 km (Lofitech ADD). Therefore, a longer ADD activation duration is no guarantee of continued displacement.
- 10.10.138 Moreover, in identifying a deterrence range of 5,400 m, an average harbour porpoise swim speed has been applied (i.e. 1.5 m/s). However, various scientific papers provided significantly faster speeds with a maximum speed of 4.3 m/s and 6.2 m/s cited by Otani *et al.* (2000) and Leatherwood *et al.* (1988), respectively.
- 10.10.139 Notwithstanding the uncertainty, it is expected that small numbers of animals could potentially be exposed to the risk of auditory injury in the high order MDS. Given that details about UXO clearance techniques to be used and charge sizes will not be available until after the consent is granted (following a pre-construction UXO survey), it is not possible to quantify the effects of UXO detonations and therefore, a residual number of animals potentially impacted is not presented within this chapter.
- 10.10.140 The Applicant will undertake a UXO risk assessment prior to construction to fully understand the possible UXOs present that require clearance. This will include size and type of UXO. The measures needed to successfully clear the identified UXOs will be detailed as per DEFRA (2025) guidance.
- 10.10.141 Final mitigation measures will be agreed in consultation with MD-LOT and NatureScot and proposed as a part the final MMMP for UXO clearance works (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). It is therefore anticipated that following receipt of more detail regarding size and number of UXO (and tailoring of Additional Mitigation measures as described above), the magnitude of this impact will be reduced to low for harbour porpoise.
- 10.10.142 The magnitude of impact in relation to high order clearance as maximum design, is anticipated to occur over a highly localised scale (for all species except harbour porpoise) and a limited spatial extent in the context of the relevant geographic frame of reference (harbour porpoise). The proportion of the impacted reference population is < 1% for all species, including harbour porpoise. The frequency is anticipated to occur occasionally/intermittently for short periods of time. The magnitude is therefore considered to be negligible for all species except harbour porpoise. To reflect the relative greater number of harbour porpoise predicted to be at risk, the magnitude is considered to be low.

Behavioural Disturbance (TTS As Proxy)

- 10.10.143 As noted above, the duration of noise emission for each UXO detonation is less than one second, and therefore, behavioural effects are considered to be negligible in this context. Southall *et al.* (2007) recommended that the use of TTS onset threshold to be the most appropriate for single pulses (such as UXO detonation). This assessment for behavioural disturbance has used the onset of TTS as a proxy for disturbance. Although this assumes the potential temporary loss in hearing, which may mean some ecological functions could be inhibited in the short-term, TTS is reversible on recovery of the animal’s hearing and therefore not considered likely to lead to any long-term effects on the individual.
- 10.10.144 Disturbance ranges for low order and high order clearance of UXO are presented in Table 10.56. The largest ranges using SEL_{cum} metric were predicted for minke whale, up to 34,275 m (720 kg NEQ; Table 10.56). Ranges predicted using peak SPL exceeded 1,000 m for all species, with the largest behavioural disturbance range predicted for harbour porpoise at 26,225 m (Table 10.56). It should be noted that impulsive noise thresholds (TTS onset) were used in the underwater noise modelling and reiterate that the sound is unlikely to retain its impulsive character once it has propagated more than a few kilometres. It is particularly important when interpreting results for disturbance at ranges larger than 10 km as these are likely to be overestimated (Hastie *et al.*, 2019) (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report).
- 10.10.145 Behavioural disturbance ranges for low order clearance of UXO are presented in Table 10.56. The largest ranges using the SEL_{cum} metric were predicted for the clearance shot of 0.5 kg NEQ (Low Order), of up to 2,475 m for harbour porpoise (Table 10.56). Ranges predicted for other species using peak SPL exceeded 500 m in some cases, with the largest behavioural disturbance range predicted again for harbour porpoise at 2,325 m (Table 10.56).

Table 10.56: Maximum Potential TTS Ranges for Low order and High Order Clearance

Species/ Group	Metric	Threshold	Range (m)			
			Low order Donor Charge (0.08 kg)	Low order Clearing Shot (0.5 kg)	High order Realistic (227 kg)	High order (720 kg)
LF	peak SPL	216dB re 1µPa	165	303	2,330	3,420
	SEL _{cum}	168dB re 1µPa ² s	715	1,725	23,210	34,275
HF	peak SPL	224dB re 1µPa	73	134	1,030	1,515
	SEL _{cum}	178dB re 1µPa ² s	6	14	985	1,595
VHF	peak SPL	196dB re 1µPa	1,265	2,325	17,850	26,225
	SEL _{cum}	144dB re 1µPa ² s	1,480	2,475	7,730	9,010
PCW	peak SPL	217dB re 1µPa	149	274	2,105	3,090
	SEL _{cum}	168dB re 1µPa ² s	222	535	6,300	8,785

- 10.10.146 The number of animals predicted to experience a behavioural disturbance due to low order clearance and high order clearance is presented in Table 10.57.
- 10.10.147 The greatest number of animals predicted to be at risk of disturbance was found for harbour porpoise at 1,373 animals, as a result of high order detonation of a 720 kg NEQ (peak SPL metric) which equates to 0.86% of the UK portion of the North Sea MU population. The second largest number of animals disturbed was predicted for the grey seal based on the SEL_{cum} metric, with up to 136 individuals potentially at risk of disturbance (0.26% of the East Scotland, North Coast and Orkney and the Moray Firth SMUs) as a result of high order detonation of 720 kg NEQ. Based on SEL_{cum}, the number of minke whale at risk of behavioural disturbance was estimated as up to 111 animals (1.09% of the UK portion of the CGNS MU). For white-beaked dolphin, the number of individuals predicted to be at risk of disturbance for the high order clearance of 720 kg NEQ was no more than two individuals (less than 0.006% of the UK portion of the CGNS MU). For harbour seal the number of individuals predicted to be at risk of disturbance was no more than three individuals for the high order detonation of 720 kg NEQ (0.23% of the East Scotland and the Moray Firth SMUs).
- 10.10.148 For bottlenose dolphin the number of animals predicted to be disturbed was very small with no more than one animal within the predicted effect zones (Table 10.57). For Risso's dolphin which are in the same functional hearing group as bottlenose dolphin, the number of animals predicted to be at risk of disturbance is anticipated to be the same or lower than bottlenose dolphin.
- 10.10.149 For fin whale, humpback whale, which are in the same functional hearing group as minke whale, the number of animals predicted to be at risk of disturbance is anticipated to be the same or lower than minke whale (see Paragraph 10.10.173).

Table 10.57: Maximum Potential Number of Animals With the Potential to Experience TTS Onset Due to Low order Clearance and High order Clearance

Metric	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Low Order Donor Charge (0.08kg)						
Peak SPL	4	<1	<1	<1	<1	<1
SEL _{cum}	5	<1	<1	<1	<1	<1
Low Order Clearance Shot (0.5 kg)						
Peak SPL	11	<1	<1	<1	<1	<1
SEL _{cum}	13	<1	<1	<1	<1	<1
High Order Realistic (227 kg)						
Peak SPL	636	<1	<1	<1	8	<1
SEL _{cum}	120	<1	<1	51	70	2

Metric	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
High Order (720 kg)						
Peak SPL	1,373	<1	2	2	17	<1
SEL _{cum}	162	<1	2	111	136	3

10.10.150 The risk of auditory injury overlap with designated sites for the high order scenario is as follows:

- The closest designated site for harbour seal is the Firth of Tay and Eden Estuary SAC 40.4 km from the Proposed Development. The largest disturbance range for seals is 8.79 km (SEL_{cum}). However, this would be within the impact buffer for harbour seal of 50 km (for more detail see the HRA, RIAA Part 2: Special Areas of Conservation (TWP-BOW-RPS-OFE-RPT-00014)), therefore there is the potential for an impact overlap connected to this SAC should high order clearance be required.
- There is no disturbance risk to grey seal in the closest SAC designated for grey seal (Isle of May SAC) as this is located 67.1 km from the Proposed Development, including the consideration of the 20 km connectivity buffer.
- There is a very low risk of disturbance to minke whale connected with the Southern Trench ncMPA, should high order clearance be required, which is located 35.9 km from the Proposed Development and the largest disturbance range for minke whale is 34.3 km.

10.10.151 For all species a small proportion of the relevant MU is predicted to be affected by strong behavioural disturbance. As such, whilst there may be effects at an individual level, these are not predicted to be at a scale that would lead to any population-level effects.

10.10.152 The assessment has considered the maximum design high order detonation of 720 kg NEQ. The impact (high order detonation) is predicted to be of localised or medium spatial extent in the context of the relevant geographic frame of reference, the duration is anticipated to be momentary, and occurring intermittently, and both the impact itself (i.e. the elevation in underwater noise during detonation event) and effect of disturbance, is reversible). The magnitude of impact is therefore considered to be low for all species.

Sensitivity of the Receptor

Auditory Injury

10.10.153 Sensitivity to auditory injury is presented within the impact piling assessment (Paragraph 10.10.38) and are therefore not repeated here in detail. There are limited studies that have assessed levels of auditory risk to marine mammals, and most have focused on harbour porpoise. Von Benda-Beckmann *et al.* (2015) studied the range of effects of explosives on harbour porpoise in the southern

North Sea. *In situ* noise measurements were taken at distances up to 2 km from the high order clearance of seven UXOs located at approximately 26 m to 28 m depth on a sandy substrate, with charge weights of up to 263 kg. Von Benda-Beckmann *et al.* (2015) investigated the potential for noise-induced auditory injury to occur based on Lucke *et al.* (2009) threshold criteria of 190 dB re. 1 $\mu\text{Pa}^2\text{s}$ ('very likely to occur') and of 179 dB re. 1 $\mu\text{Pa}^2\text{s}$ (SEL) ('increasingly likely to occur'). They concluded that noise-induced auditory injury was likely to occur greater than the 2 km range that was monitored during the study since the SEL recorded at this distance was 191 dB re. 1 $\mu\text{Pa}^2\text{s}$, i.e. 1 dB above the 'very likely to occur' threshold.

- 10.10.154 The same study also modelled possible effect ranges for 210 explosions (of up to 1,000 kg charge mass) logged by the Royal Netherlands Navy and the Royal Netherlands Meteorological Institute over a two-year period (2010 and 2011). The authors validated the model using empirical measurements out to 2 km, and found that the effect distances ranged between hundreds of metres to just over 10 km.
- 10.10.155 Porpoises are known to spend a large proportion of time near the surface (e.g. 55% based on Teilmann *et al.* (2007)) where the received levels of noise were predicted to be lower, with effect distances for the onset of auditory injury at shallow depths of up to 5 km. Salomons *et al.* (2021) analysed sound measurements taken near two high order detonations of UXO (with charge masses of 325 kg and 140 kg), and concluded that harbour porpoise were at risk of permanent hearing loss at distances of 2 km and 6 km based on 140 kg and 325 kg charge masses.
- 10.10.156 Not much is known about sensitivity of other odontocetes or mysticises to blasting. During a clearance of relatively small explosive (35 kg charge) within an important feeding area for a resident community of bottlenose dolphin in Portugal (dos Santos *et al.*, 2010), noise levels in excess of 170 dB re 1 μPa (SPL) were measured. However, no adverse effects were recorded in the behaviour of the resident community.
- 10.10.157 Notwithstanding the lack of evidence, it is considered that auditory injury to any marine mammal will be a permanent injury and could occur across a broad frequency range.
- 10.10.158 Therefore, all marine mammal receptors, are deemed to have limited resilience to auditory injury, low recoverability and adaptability. The sensitivity of the marine mammal receptor is therefore considered to be high.

Behavioural Disturbance (TTS As Proxy)

- 10.10.159 As TTS is a temporary and reversible hearing impairment, it is anticipated that any animals experiencing this shift in hearing would recover after they have moved beyond the ensonified area and are no longer exposed to elevated sound levels.
- 10.10.160 Kastelein *et al.* (2021) found that the susceptibility to TTS depends on the frequency of the fatiguing sound causing the shift and the greatest TTS depends on the SPL (and related SEL). In a series of studies reviewed in Finneran (2015), which measured TTS occurrence in harbour porpoise (VHF cetacean) at a range

of frequencies typical of high-amplitude anthropogenic sounds, the greatest shift in mean TTS occurred at 0.5 kHz with hearing recovery within 60 minutes after the fatiguing sound stopped.

- 10.10.161 Whilst there are no available species-specific recovery rates for HF cetaceans to TTS, there is no evidence to suggest that recovery will be significantly different to harbour porpoise recovery rates therefore animals can recover their hearing after they are no longer exposed to elevated sound levels. It can be anticipated that all delphinids would be able to tolerate the effect without any impact on reproduction or survival rates with the ability to return to previous behavioural states or activities once the impacts had ceased.
- 10.10.162 There are no species-specific recovery rates for minke whale, fin whale or humpback whale to TTS. It is anticipated that LF cetaceans would be able to tolerate the effect without any impact on reproduction or survival rates and is expected to return to previous behavioural states or activities once the impacts had ceased.
- 10.10.163 Kastelein *et al.* (2018) measured recovery rates of harbour seal following exposure to a sound source of 193 dB re 1 μ Pa_{2s} (SEL_{cum}) over 360 minutes and found that recovery from TTS to the pre-exposure baseline was estimated to be complete within 72 minutes following exposure. To note, this is a significantly longer exposure than would be expected from a UXO clearance event. Findings reported in SEAMARCO (2011), showed that for small TTS values, recovery in seal species was very fast (around 30 minutes). Ketten (1995) also reported relatively fast recovery, with full hearing recovery within two hours following exposure.
- 10.10.164 Impaired hearing for a short time is therefore anticipated to have little effect on the total foraging period of a seal. It is therefore likely that both grey seal and harbour seal can tolerate the effect of short-term hearing impairment without any impact on either reproduction or survival rates and would be able to return to previous behavioural states or activities once the impacts had ceased.
- 10.10.165 Any disturbance from UXO clearance is anticipated to be short-term and intermittent. It is therefore not expected that disturbance from UXO clearance activities would result in any significant impacts or result in any changes to the vital rates of individuals.
- 10.10.166 All species considered are deemed to have the ability to avoid or adapt behaviour, some tolerance (resilience) to behavioural disturbance, high recoverability. The sensitivity of all species to TTS is therefore, considered to be low.

Significance of the Effect

- 10.10.167 Although the default approach is the use of low order techniques to clear UXO (Table 10.30), conclusions are presented based on the assessment for high order clearance, which therefore presents a conservative assumption of project parameters.

Auditory Injury

- 10.10.168 For bottlenose dolphin, white-beaked dolphin, Risso's dolphin, minke whale, fin whale, humpback whale, harbour seal and grey seal, overall, the magnitude of the impact (auditory injury) is deemed to be negligible, and the sensitivity of all marine mammal receptors is considered to be high. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.
- 10.10.169 For harbour porpoise the magnitude of the impact is deemed to be low and the sensitivity of all marine mammal receptors is considered to be high. The effect will therefore be of Minor to Moderate adverse significance. The application of the finalised MMMP allows the significance conclusion of **Minor** adverse which is not significant in EIA terms.

Behavioural Disturbance (TTS As a Proxy)

- 10.10.170 Overall, the magnitude of the impact (behavioural disturbance) is deemed to be low for all species, and the sensitivity of all marine mammal receptors is considered to be low. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

Auditory Injury

- 10.10.171 For all species excluding harbour porpoise, no Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.
- 10.10.172 However, Additional Mitigation measures may need consideration post-consent due to the potential residual risk to harbour porpoise in the event of a high order clearance. These measures will be tailored once a more detailed understanding of the size and number of UXO is available, will be discussed with stakeholders and proposed as part of the final MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol).
- 10.10.173 The Applicant will undertake a UXO risk assessment prior to construction to understand the possible UXOs (pUXO) that require clearance. This may include (but is not necessarily limited to) details such as the size and type of UXO. The UXO risk assessment may also detail measures needed to clear the identified UXOs with reference to DEFRA, 2025 guidance (see Volume 3, Technical Appendix 4.6: Schedule of Mitigation and Commitments).
- 10.10.174 Therefore, prior to the commencement of UXO clearance works, if required appropriate Additional Mitigation measures will be discussed with MD-LOT and NatureScot, and proposed as a part the final MMMP for UXO clearance works (Volume 4, Appendix 26 Outline Marine Mammal Mitigation Protocol). It is therefore anticipated that following receipt of more detail regarding size and number of UXO (and tailoring of Additional Mitigation measures as described above), the magnitude of this impact will be confirmed as low for harbour porpoise.

Behavioural Disturbance (TTS as a Proxy)

- 10.10.175 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

IMPACT 3: INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING SITE-INVESTIGATION SURVEYS

- 10.10.176 Site-investigation surveys during the construction and O&M phases have the potential to cause direct or indirect effects (including injury or disturbance) to marine mammal receptors (Table 10.19). A detailed underwater noise modelling assessment has been carried out to investigate the potential for injurious and behavioural effects on marine mammals as a result of geophysical and geotechnical surveys, using the latest criteria (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). Several sonar-like sources will potentially be used for the geophysical surveys, including Multibeam Echo Sounder (MBES), SSS, SBP and UHRS sources. The equipment likely to be used can typically work at a range of signal frequencies depending on the distance to the seabed and the required resolution. For sonar-like sources the signal is highly directional, acts like a beam and is emitted in pulses. Sonar-based sources are considered by the NMFS (2018) as continuous (non-impulsive) because they generally comprise a single (or multiple discrete) frequency. Unlike the sonar-like survey sources, the UHRS is likely to utilise a sparker, which produces an impulsive, broadband source signal. Additionally, a magnetometer may be used to measure and detect anomalies within the existing magnetic field, although no subsea noise is generated. The survey parameters, such as source sound levels used in the underwater noise modelling are presented in detail in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report. For geotechnical surveys, potential equipment to be used may include Cone Penetration Test (CPT), vibrocore, piston core, box core and borehole (Table 10.19).
- 10.10.177 The site-investigation surveys as listed in Table 10.19 will take place during the pre-construction phase and O&M phase. During the pre-construction phase up to 14 geophysical and geotechnical vessels will be on site at any one time, with up to 110 vessel movements (return trips) in total. The number of vessels and return trips for geophysical and geotechnical surveys in the O&M phase is expected to be similar to the pre-construction phase.

Construction Phase

Magnitude of Impact

Auditory Injury

- 10.10.178 As detailed in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report, auditory injury ranges for impulsive survey sources (UHRS) are based on a comparison to the Southall *et al.* (2019) and NMFS (2024) thresholds for impulsive noise, whereas non-impulsive survey sources (MBES, SSS, SBP, borehole, vibrocore) results are compared against the non-impulsive thresholds. Please note that in this chapter, only the NMFS (2024) results will be presented.

- 10.10.179 The maximum AUD INJ range across all geophysical surveys was estimated as 251 m for harbour porpoise (SSS LF; Table 10.58). For bottlenose dolphin, white-beaked dolphin, Risso’s dolphin, minke whale, fin whale, humpback whale, harbour seal and grey seal the maximum auditory injury is estimated to occur out to 86 m (Table 10.58). However, it should be noted that as sonar-like sources have very strong directivity (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report), there is only potential for auditory injury when a marine mammal is directly underneath the noise source. Once the animal moves outside of the main beam, there is no potential for auditory injury.
- 10.10.180 The auditory injury threshold was not exceeded for all marine mammal species for geotechnical investigation activities and therefore as non-impulsive sound sources, these are not discussed further (see Table 10.12: S).
- 10.10.181 The number of marine mammals predicted to experience auditory injury within the modelled auditory injury ranges were estimated using species-specific density estimates (Table 10.59). Given that the potential auditory injury ranges are small, no more than one animal of each species is deemed to be at risk of experiencing auditory injury across all types of geophysical surveys (Table 10.59).
- 10.10.182 The AUD INJ ranges will not overlap with any known designated areas for any of the species (Table 10.18, Figure 10.3).

Table 10.58: Potential Injury (AUD INJ) Impact Ranges (m) for Geophysical Site-Investigation Surveys (N/E = Threshold Not Exceeded)

Survey type	Potential AUD INJ Range (m)			
	Harbour porpoise	Bottlenose dolphin, White-beaked dolphin and Risso’s dolphin	Minke whale, Fin whale and Humpback whale	Grey seal & Harbour seal
MBES	165	8	N/E	N/E
SSS LF	251	60	N/E	5
SSS HF	45	N/E	N/E	N/E
SBP (chirp/pinger)	170	86	25	86
UHRS (sparker)	17	N/E	N/E	N/E

Table 10.59: Estimated Number of Animals with the Potential to Experience AUD INJ During Geophysical Site-Investigation Surveys (N/E = Threshold Not Exceeded)

Survey Type	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Geophysical Surveys						
MBES	<1	<1	<1	N/E	N/E	N/E
SSS LF	<1	<1	<1	N/E	<1	<1
SSS HF	<1	N/E	N/E	N/E	N/E	N/E
SBP (chirp/pinger)	<1	<1	<1	<1	<1	<1
UHRS (sparker)	<1	N/E	N/E	N/E	N/E	N/E

10.10.183 Site-investigation surveys are considered to be short-term activities. In line with good practice guidance, measures designed during geophysical surveys will involve the use of MMOs and PAM so that the risk of injury over the defined mitigation zone is reduced (JNCC, 2017). The largest auditory injury range was estimated as 251 m for SSS LF (VHF cetaceans) and it is considered that standard industry measures will be effective at reducing the risk of injury to negligible over this distance (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol).

10.10.184 The impact (auditory injury from elevated underwater noise during site-investigation surveys) is predicted to be of local spatial extent, short-term duration, intermittent, and although the impact itself is reversible (i.e. the elevation in underwater noise only occurs during surveys), the effect of auditory injury is permanent. It is predicted that the impact will affect the marine mammal receptor directly. Since the injury is presumed to be fully mitigated via measures designed in, there is considered to be no residual risk of injury and therefore no population-level effects; the magnitude is therefore considered to be negligible for all receptors.

10.10.185 As part of the Embedded Mitigation measures (Table 10.30) standard mitigation from JNCC (2017) will be adhered to for the geophysical surveys, which will involve the use of MMOs/PAM monitoring (Table 10.30). Where possible, soft starts will be applied for electromagnetic equipment (such as SBP and SSS) as well as seismic sources (UHRS).

Behavioural Disturbance

10.10.186 For impulsive noise sources (UHRS) the underwater noise modelling adopted the NMFS (2005) thresholds of 140 dB re 1 µPa for mild disturbance and 160 dB re 1 µPa for strong disturbance. For non-impulsive noise sources (MBES, SSS, SBP, borehole, vibrocore) the underwater noise modelling used the NMFS (2005) threshold of 120 dB re 1 µPa. The underwater noise modelling predicted that the

behavioural effects as a result of site-investigation surveys could occur within a range of between 283 m (SSS HF) and up to 9,145 m (vibrocore) (Table 10.60).

- 10.10.187 For impulsive noise sources (UHRS), the strong behavioural disturbance ranges are predicted to occur up to 80 m from the source (Table 10.60). No more than one animal of each species would be at risk of experiencing strong behavioural disturbance. Mild disturbance may occur within 552 m of the sources during UHRS, for all species (Table 10.60). However, no more than one animal of each species would be at risk of experiencing mild behavioural disturbance (Table 10.61). It is considered that low level disturbance could lead to mild disruptions of normal behaviours, but prolonged or sustained behavioural effects, including displacement, are unlikely to occur.
- 10.10.188 For non-impulsive noise sources (MBES, SSS, SBP, borehole drilling, vibrocore), no more than one animal is predicted to be disturbed during MBES, SSS and borehole drilling. With the use of SBP, up to four harbour porpoise are at risk of experiencing disturbance and up to three grey seal. Due to relatively large disturbance ranges predicted for vibrocore, based on conservative species-specific densities, up to 167 harbour porpoise could experience disturbance (Table 10.61). Vibrocore may also lead to disturbance of up to two bottlenose dolphin, 41 white-beaked dolphin, eight minke whale, three harbour seal and up to 148 grey seal (Table 10.61). However, for those animals disturbed, there is likely to be a proportional response, i.e. not all animals will be disturbed to the same extent. There is no dose-response curve available to apply in the context of site-investigation surveys. However, Joy *et al.* (2019) derived a dose-response for killer whale and underwater noise from vessels, indicating that marine mammals display a proportional response to non-impulsive noise. It is important to note that the life history of an individual and the context will also influence the likelihood of an individual to exhibit an aversive response to noise. Furthermore, this threshold does not consider ambient sound levels in the area, which may already be above the 120 dB re 1 μ Pa (Farcas *et al.*, 2020). Considering that the underwater noise modelling used a single threshold that does not consider the ambient noise, the numbers of animals potentially disturbed presented for vibrocore and other site-investigation surveys are likely to be an overestimate.
- 10.10.189 The behavioural disturbance ranges will not overlap with any known designated areas for any of the species (Table 10.16; Figure 10.3).

Table 10.60: Potential Disturbance Ranges for Geophysical and Geotechnical Site-Investigation Surveys

Survey Type	Potential Disturbance Range (m) for All Species
Geophysical Surveys	
MBES	490
SSS LF	530
SSS HF	283
SBP (chirp/pinger)	1,275

Survey Type	Potential Disturbance Range (m) for All Species	
UHRS (sparker)	Mild: 80	Strong: 552
Geotechnical Surveys		
Borehole drilling	294	
Vibrocoring	9,154	

Table 10.61: Estimated Number of Animals with the Potential to be Disturbed During Geophysical and Geotechnical Site-Investigation Surveys

Survey Type	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Geophysical Surveys						
MBES	<1	<1	<1	<1	<1	<1
SSS LF	<1	<1	<1	<1	<1	<1
SSS HF	<1	<1	<1	<1	<1	<1
SBP (chirp/pinger)	4	<1	<1	<1	3	<1
UHRS (mild)	<1	N/E	N/E	N/E	N/E	N/E
UHRS (strong)	<1	<1	<1	<1	<1	<1
Geotechnical Surveys						
Borehole drilling	<1	<1	<1	<1	<1	<1
Vibrocoring	167	2	41	8	148	3

10.10.190 The impact (disturbance from elevated underwater noise during site-investigation surveys) is predicted to be of local to regional spatial extent, short-term duration, intermittent, and the effect of behavioural disturbance is of high reversibility (with animals returning to baseline levels soon after surveys have ceased). It is predicted that the impact will affect the marine mammal receptor directly. Whilst there may be effects at an individual level, these are not predicted to be at a scale that would lead to any population-level effects. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

Auditory Injury

- 10.10.191 Ruppel *et al.* (2022) categorised marine acoustic sources into four tiers based on their potential to injure marine mammals using physical criteria about the sources (e.g. source level, transmission frequency, directionality, beamwidth, and pulse repetition rate). Those in Tier Four were considered unlikely to result in ‘incidental take’ (i.e. loss of individuals) of marine mammals and therefore termed *de minimis*, and included most high-resolution geophysical sources (MBES, SSS, SBP, low-powered sparkers). For context, Tier 1 refers to high-energy airgun surveys with a total volume larger than 1500 in or arrays with more than 12 airguns, Tier 2 covers the remaining low/intermediate energy airgun and Tier 3 covers most non-airgun seismic sources, which either have characteristics that do not meet the *de minimis* category (e.g., some sparkers) or could not be fully evaluated in Ruppel *et al.* (2022) (e.g., bubble guns, some boomers). The study also suggested surveys that simultaneously deploy multiple, non-impulsive *de minimis* sources are unlikely to result in incidental take of marine mammals.
- 10.10.192 Although the likelihood of any receptor experiencing auditory injury is minimal, all receptors are deemed to have limited resilience (tolerance) to auditory injury, and limited ability for the receptor to recover (recoverability). The sensitivity of the receptor is therefore considered to be medium.

Behavioural Disturbance

- 10.10.193 It is widely recognised that the transmission frequencies of commercial sonar systems (approximately 12 kHz to 1800 kHz) overlap with the hearing ranges of many marine mammal species (Richardson *et al.*, 1995). Many frequencies associated with sonar systems are very high and have peak frequencies well above marine mammal hearing ranges.
- 10.10.194 Ruppel *et al.* (2022) reported that in response to sonar-like sound sources (e.g. MBES, singlebeam echosounder (SBES)), marine mammals may show subtle behavioural responses, although species, behavioural context, location, and prey availability are likely to play more of a role than the acoustic signals themselves. In a study undertaken by MacGillivray *et al.* (2014), seven acoustic sources (including air guns, SBP, MBES and SSS) were compared, and the sound level above hearing threshold was documented as a function of horizontal distance. Weighting sounds according to hearing sensitivity allows assessment of relative risks associated with exposure, and whilst this analysis did not directly relate to the potential for behavioural responses, it allowed comparison of modelled acoustic sources. The modelling undertaken in MacGillivray *et al.* (2014) suggested that odontocetes were most likely to hear sounds from mid-frequency sources (such as fisheries, communication, and hydrographic systems), whilst mysticetes, were most likely to hear sounds from LF sources (SBP and airguns), and pinnipeds from both mid and LF sources. For all species included within the study, modelled sensation levels were lowest for the HF sources (e.g. SSS and MBES) which operate at the upper limits of the audible spectrum.

- 10.10.195 A recent study by Kates Varghese *et al.* (2021) on MBES surveys showed that the only marine mammal metric that was identified as changing was vocalisation rate, with neither changes in displacement nor foraging being observed. Similarly, Quick *et al.* (2017) reported that tagged short-finned pilot whale *Globicephala macrorhynchus* that were exposed to a SBES did not change their foraging behaviour, but variance in directionality of movement was observed, suggesting increased vigilance whilst the SBES was active. It was, however, stated that the range of behaviours exhibited could not be directly attributed to SBES operation, and that changes in behaviour were unlikely to be biologically significant. A study by Cholewiak *et al.* (2017) investigated the impact of SBES on toothed whales and reported that fewer beaked whale vocalisations were recorded when the source was actively transmitting. This suggested that animals either move away from the area or reduced foraging activity (although findings were not statistically significant).
- 10.10.196 Many studies to date have focused on the effects of multi-array seismic surveys on marine mammals, and therefore there is less widely available evidence for behavioural responses to seismic sources (e.g. MBES, SSS, SBPs). Multi-array impulsive sound sources are broadband in character (i.e. produce sound across a wide range of frequencies), unlike seismic sources, which typically produce more tonal sound either at a discrete frequency or a range of discrete frequencies. However, findings from studies of multi-array impulsive sources may be useful in supporting predictions of behavioural responses of marine mammals to geophysical survey sources in general, given the overlap of parameters that typically characterise sound sources (i.e. transmission frequency; source level; pulse duration) (see MacGillivray *et al.* (2014), Ruppel *et al.* (2022)). Whilst evidence on the behavioural responses to MBES is limited, an Independent Scientific Review Panel deemed a 12 kHz MBES to be the most plausible trigger for an extreme behavioural response in melon-headed whale *Peponocephala electra*, which resulted in a mass group stranding in a shallow lagoon in Madagascar in 2008 (Southall *et al.*, 2013) (an area where such open-ocean species would not usually frequent). Whilst an unequivocal cause and effect relationship between MBES and the strandings cannot be concluded, the paper states that intermittent, repeated sounds of this nature could present a salient and potential aversive stimulus and suggests potential for such behavioural responses (or indirect injury) from MBES should be considered in environmental assessments (Southall *et al.*, 2013).
- 10.10.197 Thompson *et al.* (2013) used PAM and DAS to study changes in the occurrence of harbour porpoise across a 2,000 km² study area during a commercial two-dimensional seismic survey in the North Sea. Although site-investigation surveys are considered to be lower in impact magnitude in comparison to seismic, it is useful to consider small seismic sources for context. Thompson *et al.* (2013) found that acoustic detections decreased significantly during the survey period in the impact area compared with a control area, but this effect was small in relation to natural variation. Animals were typically detected again at affected sites within a few hours, and the level of response declined through the survey period (ten days) suggesting exposure led to some tolerance of the activity (Thompson *et al.*, 2013). The authors suggested that prolonged seismic

survey sound did not lead to broader-scale displacement into sub-optimal or higher risk habitat. Similarly, a ten-month study of overt responses to seismic exploration in humpback whale, sperm whale *Physeter macrocephalus* and Atlantic spotted dolphin *Stenella frontalis*, demonstrated no evidence of prolonged or large scale displacement of each species from the region during the survey (Weir, 2008).

- 10.10.198 Behavioural response tests to two sonar systems (200 kHz and 375 kHz systems) have been carried out on grey seal at the SMRU seal holding facility (Hastie *et al.*, 2014). Results showed that both systems had significant effects on seal behaviour, with significantly more time spent hauled out during the 200 kHz sonar operation and although animals remained swimming during operation of the 375 kHz sonar, they were distributed further from the sonar.
- 10.10.199 It is expected that, to some extent, all marine mammal receptors will be able to withstand temporary elevated levels of underwater sound during site-investigation surveys and behavioural responses are highly context specific.
- 10.10.200 All marine mammal receptors are deemed to have the ability to avoid or adapt behaviour, some tolerance (resilience) to behavioural disturbance, and the ability to recover from any impact. The sensitivity of the marine mammal receptor is therefore, considered to be low.

Significance of the Effect

Auditory Injury

- 10.10.201 Overall, for all marine mammal receptors, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

- 10.10.202 Overall, for all marine mammal receptors, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be low. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.203 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

O&M Phase

Magnitude of Impact

- 10.10.204 Elevated underwater noise generated during the site-investigation surveys may lead to injury and/or disturbance to marine mammals during the O&M phase. The MDS comprises routine geophysical surveys such as MBES and SBP (Table 10.19) which will take place during the O&M phase.

- 10.10.205 The potential impacts from auditory injury due to elevated underwater noise during site-investigation surveys is described in Paragraph 10.10.178 *et seq.* for the construction phase and has not been reiterated here for the O&M phase. Similarly, the magnitude of potential impacts for behavioural disturbance to marine mammals is described in Paragraph 10.10.186 *et seq.* In terms of behavioural disturbance, underwater noise from geophysical surveys is not considered to result in a tangible alteration to the distribution of marine mammals, and these surveys are anticipated to be short-term in nature, targeted to localised areas and occur intermittently over the O&M phase. Therefore, the impact is likely to be the same or less (due to highly targeted short surveys), than the impact assessed in the construction phase.
- 10.10.206 For injury, the impact (elevated underwater noise during the geophysical surveys) is predicted to be of local spatial extent within the relevant geographic range of reference, short-term duration, intermittent and the effect of auditory injury is permanent. It is predicted that the impact will affect the marine mammal receptor directly. Since the injury is assumed to be fully mitigated via measures designed in, there is considered to be no residual risk of injury and therefore no population-level effects. The magnitude of impact for auditory injury was therefore considered to be negligible.
- 10.10.207 For the behavioural disturbance, the impact (elevated underwater noise during the geophysical surveys) is predicted to be of local to regional spatial extent within the relevant geographic range of reference, short-term duration, intermittent and the effect of behavioural disturbance is reversible (with animals returning to baseline levels soon after surveys have ceased). It is predicted that the impact will affect the receptor directly. Whilst there may be effects at an individual level, these are not predicted to be at a scale that would lead to any population-level effects. The magnitude of impact was therefore considered to be low.

Sensitivity of the Receptor

- 10.10.208 The sensitivity of the receptors during the O&M phase is not expected to differ from the sensitivity of the receptors during the construction phase. Therefore, the sensitivity of marine mammal receptors to elevated underwater noise during site-investigation surveys (auditory injury and behavioural disturbance) is as described previously in Paragraph 10.10.191 *et seq.*, where it has been assessed as medium for auditory injury and low for behavioural disturbance.

Significance of the Effect

Auditory Injury

- 10.10.209 Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the marine mammal receptor is considered to be medium. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse significance, on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

- 10.10.210 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the marine mammal receptor is considered to be low. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse significance, on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.211 No Additional Mitigation is considered necessary therefore because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

IMPACT 4: INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED BY VESSEL USE AND OTHER NOISE PRODUCING ACTIVITIES

- 10.10.212 Injury and disturbance from subsea noise generated by vessel use and other noise producing activities may arise due to vessel movements and other activities during the installation of the Wind Turbines and OSPs, the installation and/or maintenance of IAC and the Offshore Export Cables. Disturbance may result from both the presence of vessels and vessel noise emissions, however at present it is not possible to disentangle the effect from presence versus noise, therefore the assessment has focused on the risk of disturbance due to the noise emissions. This impact is relevant to the construction, O&M and decommissioning phases of the Proposed Development and may cause indirect impacts to marine mammal receptor.
- 10.10.213 Modelling was undertaken based on the MDS as outlined in Table 10.19 with a detailed assessment provided in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report.
- 10.10.214 Increased vessel movements and other subsea noise producing activities during the construction, O&M, and decommissioning phases have the potential to result in a range of effects to marine mammals such as injury, avoidance behaviour or displacement and masking of vocalisations or changes in vocalisation rate.
- 10.10.215 The assessment of elevated subsea noise due to vessel use and other (non-piling) sound-producing activities is based on a vessel and/or activity basis, considering the maximum injury/disturbance range as modelled in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report. However, several activities could be potentially occurring at the same time and therefore ranges of effects may extend from several vessels/locations where the activity is carried out and potentially overlap.

Construction Phase

Magnitude of Impact

- 10.10.216 During the construction phase of the Proposed Development, the increased levels of vessel activity will contribute to background subsea noise levels. The MDS for pre-construction activities associated with the Proposed Development assumes up to a total of 18 vessels to be present within the Site Boundary at any one time making up to 140 return trips over the duration of the pre-construction phase (over two years). During construction, a total of 16 vessels will be working on the Offshore Export Cables at any one time, with an

estimated 449 return trips in total. Predicted vessel activity for the Array Area in terms of the number of vessels onsite at any one time (25 vessels) and return trips (1,671). Detailed information about numbers of each type of vessel along with number of return trips for each is provided in Table 10.19. Vessel types include Jack-up/DP, heavy transport, scour protection, grouting, drilling, support vessels (dive, trenching), tugs, cable laying/installation (and burial), guard, survey, CTVs, boulder, sandwave and UXO clearance vessels.

- 10.10.217 Whilst there will be an uplift in vessel activity during the site preparation and construction phases of the Proposed Development, the movements will be limited to within the Site Boundary and are likely to follow existing shipping routes to and from the ports. Based on long-term vessel Automatic Identification System (AIS) traffic data vessels over the 12-months between May 2024 and April 2025, defined routes of heavy traffic were recorded through the Shipping and Navigation Study area (Volume 3, Technical Appendix 14.1: Shipping and Navigation Navigational Risk Assessment) (Figure 10.25). Baseline vessel traffic types through the Shipping and Navigation Study area included cargo vessels (2,238 tracks), tankers (1,126 tracks), ferries (10 tracks), cruise ships (247 tracks), fishing vessels (1,365 tracks), recreational vessels (310 tracks), tug and service vessels (5,316 tracks). Within the Array Area, there were 768 cargo vessel tracks, 166 tanker tracks, 1 ferry tracks, 46 cruise ships tracks, 197 fishing vessel tracks, 10 recreational vessels tracks, 547 tug and service vessel tracks. The AIS data shows a seasonal trend that peaks over the summer months (May to July) and remains slightly elevated until after September. Largely driven by cruise visits, ferry operations and recreational activity in summer months and fishing vessels. Within the Offshore Export Cable Corridor there were 779 cargo vessel tracks, 862 tanker tracks, 6 ferry tracks, 177 cruise ships tracks, 550 fishing vessel tracks, 105 recreational vessels tracks and 1,565 tug and service vessel tracks.
- 10.10.218 During site-specific vessel traffic surveys in summer (July 2023 and July 2025) and winter (January 2024 and December 2025), an average of 25.3 vessels per day (average of 354 in total) was recorded in the Survey Area (Array Area plus 10 nm) in the summer surveys and an average of 13.5 vessels per day (average of 189 in total) in the winter surveys. Within the Bowdun Array Area, an average of 5.8 per day were recorded during summer and an average of 3.4 per day during the winter. Recreational and cruise vessels were only recorded during the summer surveys, all other vessel types were recorded in both winter and summer surveys in the Survey Area and Array Area. Therefore, the increased levels of vessel activity in the construction phase is unlikely to represent a significant uplift in vessels from the baseline.

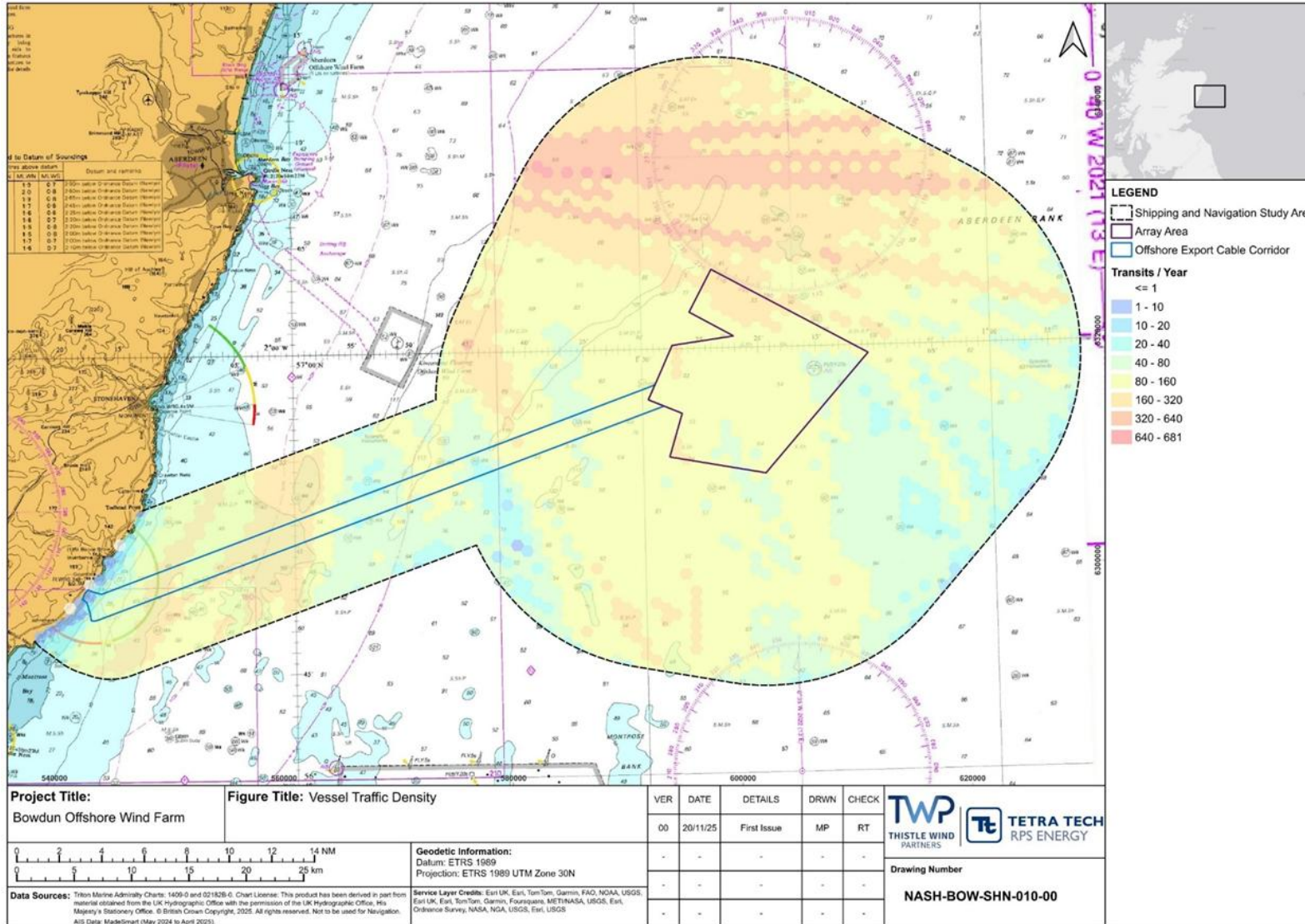


Figure 10.25: Vessel Traffic Density (September 2023 to August 2024) in the Shipping and Navigation Study Area, from Volume 3, Technical Appendix 14.1: Shipping and Navigation Navigational Risk Assessment

- 10.10.219 The main drivers influencing the magnitude of the impact of subsea noise are vessel type, speed and ambient sound levels. It has been suggested vessel type and speed rather than presence are relevant factors (e.g. 75% of all negative reactions of harbour porpoise in south-west Wales were in response to high-speed planing-hulled vessels, with the remainder being neutral responses (Oakley *et al.*, 2017)), and reactions are different dependent on vessel type, distance and speed (Wisniewska *et al.*, 2018a). As detailed in see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report), source levels for vessels depend on the vessel size and speed as well as propeller design and other factors and there can be considerable variation in magnitude and character between vessels even within the same class. Therefore, source data for the assessment has been based on the MDS and precautionary assumptions (i.e. using data toward the higher end of the scale for the relevant class of ship as a proxy).
- 10.10.220 A detailed subsea sound modelling assessment has been carried out to investigate the potential for injurious and behavioural effects on marine mammals resulting from elevated subsea noise from vessels and non-piling activity, using the latest criteria from NMFS (2024) (vessel noise is classed as non-impulsive, see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). A conservative assumption has been made that all individual marine mammals will respond aversively to increases in vessel noise (i.e. that there is no intra or interspecific variation or context-dependent differences). This is a precautionary approach as in reality, the distance over which effects may occur will vary according to the species, the ambient sound levels, hearing ability, vertical space use and behavioural response differences. Furthermore, vessel noise will be temporary and transitory, as opposed to permanent and fixed. In this respect, vessel sound originating from the Proposed Development is unlikely to differ significantly from vessel traffic already in the area.
- 10.10.221 Embedded Mitigation measures adopted as part of the Proposed Development include the development of and adherence to an Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan), which includes adherence by vessels to guidelines laid out in the SMWWC (Table 10.30). The Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) will include requirements to not deliberately approach marine mammals as a minimum, avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride and to remain at safe speeds at all times and reduce speed when a marine mammal is in the vicinity.

Auditory Injury

Vessel Noise

- 10.10.222 For vessel noise, sound exposure (SEL_{cum}) has been estimated for each source based on 24 hours continuous operation; however, due to the mobile nature of marine mammals, it is highly unlikely that any marine mammal would stay at a stationary location or within a fixed radius of a vessel (or any other sound source, particularly for 24 hours) and therefore the subsea noise modelling has been undertaken based on an animal swimming away from the source (or the

source moving away from an animal, see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for more details).

- 10.10.223 The subsea noise modelling results indicate that the threshold for auditory injury was not exceeded for all species, for all vessel types. Furthermore, it should be noted that the injury ranges based on SEL threshold do not take into account any ambient noise levels and therefore are likely to be over precautionary. With Embedded Measures in place, e.g. adherence to a NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan)(see Table 10.30) where vessels will not deliberately approach animals and will remain at low speeds, the risk of auditory injury to marine mammals is considered to be negligible. The Embedded Mitigation to reduce the risk of injury to marine mammals (Table 10.30) will be followed at all times.
- 10.10.224 The impact is predicted to be of highly local spatial extent, and the effect is highly unlikely to occur. The magnitude is therefore considered to be negligible.

Other Construction Activities

- 10.10.225 Up to 268 days of pile installation could require drilling (for 4-leg piled jacket and OSPs) (Table 10.19) and may be a source of non-piling subsea noise. Drilling could also be required if monopiles were installed, however 4-leg piled jacket and OSPs scenario represents the maximum number of days that drilling could occur over. The subsea noise modelling found that the auditory injury threshold will not be exceeded for all marine mammals exposed to drilled pile installation (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report).
- 10.10.226 The impact is predicted to be of highly local spatial extent, and the effect is highly unlikely to occur. The magnitude is therefore considered to be negligible.

Behavioural Disturbance

Vessel Noise

- 10.10.227 Behavioural disturbance from vessel noise is likely to occur only where vessel sound associated with the Proposed Development exceeds the background ambient sound level. The Site Boundary is located in waters with relatively high traffic (see Paragraph 10.10.217) associated with maritime transport, hence the presence of a high proportion of cargo vessels amongst all recorded vessels. Considering the current baseline levels of vessel traffic, it can be anticipated that marine mammals present in the vicinity of the Local Marine Mammal Study Area are exposed to some level of background noise.
- 10.10.228 For non-impulsive (continuous) sound sources, such as from vessels, there is a single available threshold (120 dB re 1 μ Pa (rms) based on NMFS (2005)), proposed as the basis for the onset of a behavioural reaction. However, it must be noted that thresholds that relate single exposure parameters (e.g. received sound level) to behavioural responses across species and sound types may lead to oversimplification in prediction of effects. Ideally, differences between species, situational context, spatial scales and interacting effects of multiple stressors would be quantified to predict effects, but Southall (2021) highlights that few studies report this critical data in a systematic, structured way. Using a single threshold assumes that 100% of animals above this threshold are

disturbed, whilst in reality, for those animals disturbed there is likely to be a proportional response (i.e. not all animals will be disturbed to the same extent). Joy *et al.* (2019) derived a dose-response for killer whales and subsea noise from vessels, indicating that marine mammals display a proportional response to non-impulsive noise. However, there is no dose-response curve available to apply in the context of non-impulsive sound sources for key species in the North Sea.

- 10.10.229 JNCC *et al.* (2010) state that “it is most unlikely that a passing vessel would cause more than trivial disturbance. It is the repeated or chronic exposure to vessel noise that could cause disturbance”. Therefore, it is important to note that the 120 dB re 1 μ Pa (rms) criterion is very precautionary and that ambient sound levels in the North Sea could well exceed this value (NMFS, 2005; Xodus, 2014). This conservative assumption has been corroborated by Farcas *et al.* (2020) where the authors constructed a computational model of subsea noise levels in the North-East Atlantic using AIS data and environmental parameters and found that the annual median broadband noise level exceeded 120 dB re 1 μ Pa around offshore installations in the northern North Sea. It is anticipated that the background noise levels within the Local Marine Mammal Study Area are likely to often exceeding the 120 dB re 1 μ Pa (rms) criterion. Therefore, behavioural disturbance ranges and number of animals potentially disturbed presented in this section should be interpreted with caution.
- 10.10.230 The estimated ranges within which there is a potential for disturbance to marine mammals are presented in Table 10.62 (see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report for further detail). Scour/cable protection/seabed preparation/installation vessels, survey vessel and support vessels resulted in the greatest modelled disturbance out to 5,597 m for all species (Table 10.62). The greatest disturbance range for other non-vessel continuous sound behavioural effects was predicted to be 4,493 m due to cable trenching/cutting (Table 10.62).

Table 10.62: Estimated Potential Disturbance Ranges from Different Vessels and Other Activities for All Marine Mammals (N/E= Threshold Not Exceeded)

Source/Vessel	Potential Disturbance Range (m) All Species
Sandwave clearance vessel	4,743
Boulder clearance, offshore construction vessel	474
Installation vessel, construction vessel (DP)	4,743
Jack-up rig	N/E
Tug/anchor handlers	4,436
Rock placement vessel and cable installation vessels	4,743
Guard vessels	4,436
Survey vessel and support vessels	5,597
CTV	5,597
Scour/Cable Protection/Seabed Preparation/Installation Vessels	5,597
Cable laying	4,540

Source/Vessel	Potential Disturbance Range (m) All Species
Cable trenching/cutting	4,493
Drilled piling	407

10.10.231 The number of animals predicted to experience behavioural disturbance due to vessel use and other noise producing activities is presented in Table 10.63. The largest number of animals affected was found for harbour porpoise where up to 63 animals (0.04% of the UK portion of the North Sea MU) could experience disturbance as a result of scour/cable protection/seabed preparation/installation vessels, survey vessel and CTV. The second largest number of animals disturbed was predicted for grey seal with up to 56 individuals potentially disturbed (0.1% of the East Scotland and North Coast and Orkney and Moray Firth SMUs) due to the activity of the same type of vessels as listed for harbour porpoise (Table 10.63). The third largest number of animals affected was found for harbour porpoise where up to 45 animals (0.03% of the UK portion of the North Sea MU) could experience disturbance as a result of sandwave clearance, rock placement and installation vessels (Table 10.63).

10.10.232 For all other marine mammals, the number of animals predicted to be disturbed was very small with no more than 16 animals within the predicted effect zones (Table 10.63). It is important to highlight that multiplying numbers of animals presented in Table 10.63 by the numbers of vessels expected over the site preparation and construction phases (Table 10.19) could lead to unrealistic estimates as it does not allow for any overlap between vessels (and therefore would double count), nor does it account for periods when vessels are stationary.

10.10.233 The behavioural disturbance ranges will not overlap with any known important or designated areas for any of the species (the maximum behavioural disturbance range is 5,597 m and the nearest designated site (Southern Trench ncMPA) is 35.9 km from the Proposed Development (Table 10.16; Figure 10.3: Marine Mammal Relevant Designated Sites).

Table 10.63: Maximum Number of Animals with the Potential to Experience Disturbance Due to Vessel Use and Other Subsea Noise producing Activities

Survey Type	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Sandwave clearance, Installation vessel, construction vessel (DP), Rock placement vessel and cable installation vessels	45	<1	11	3	40	<1
Boulder clearance, offshore construction vessel	<1	<1	<1	<1	<1	<1
Jack-up rig	N/E	N/E	N/E	N/E	N/E	N/E

Survey Type	Number of Animals					
	Harbour porpoise	Bottlenose dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Tug/anchor handlers and Guard vessels	40	<1	10	2	35	<1
Survey vessel and support vessels, Scour/Cable Protection/Seabed Preparation/Installation Vessels	63	<1	16	3	56	<1
CTV	63	<1	16	3	56	<1
Cable laying	42	<1	11	2	37	<1
Cable trenching/cutting	41	<1	10	2	36	<1
Drilled piling	<1	<1	<1	<1	<1	<1

10.10.234 For all species, the impact is predicted to be of local spatial extent, the effect is anticipated to be temporary, at LF, the magnitude is therefore considered to be low.

Other Construction Activities

10.10.235 The subsea noise modelling found that the disturbance range for drilled piling was out to 407 m, comparable to disturbance ranges from boulder clearance and offshore construction vessels.

10.10.236 For all species, the impact is predicted to be of local spatial extent, the effect is anticipated to be temporary, at LF, the magnitude is therefore considered to be low.

Sensitivity of the Receptor

Auditory Injury

10.10.237 The sensitivity of marine mammal receptors to auditory injury has been assessed in detail in Paragraph 10.10.93 *et seq.* and therefore is not reiterated here. Auditory injury ranges from vessels involved in the construction phase (non-impulsive sound) are far smaller than auditory injury ranges for piling (impulsive sound) and the numbers of animals at risk of injury are very low for all species.

10.10.238 Although auditory injury is considered to be a permanent reduction in hearing ability, all receptors are considered to be able to avoid or adapt behaviour, with some tolerance to the effect. The sensitivity of all receptors is therefore considered to be medium.

Behavioural Disturbance

- 10.10.239 The degree of disturbance experienced by marine mammals will be dependent on a number of factors, including; individual hearing ranges and background noise levels, together with individual context (e.g. habituation to noise/vessel presence) and motivation to remain in the area (i.e. key foraging area) (IWC, 2006; Senior *et al.*, 2008).
- 10.10.240 The evidence presented here relating to behavioural responses draws upon observed reactions relative to large ship activity (e.g. tankers) and shipping lanes, to smaller planning craft. The size and speed affect the noise characteristics for each vessel type (Richardson *et al.*, 1995) and therefore marine mammal response to vessel activity is also likely to be influenced on the size and speed of each vessel. The evidence is highly linked to the circumstances of each source described and is presented to highlight the variability in response that can be observed.
- 10.10.241 Oakley *et al.* (2017) found varied negative reactions in response to boat speed. Cargo, recreational fishing and speedboats were the main vessel types accounting for negative reactions in this study. It is worth noting that these vessel types already occur frequently as part of the baseline for the Proposed Development (Paragraph 10.10.233). Hao *et al.* (2024) found harbour porpoise responses were linked to the speed of the approaching boat and therefore the rate of change in noise level, rather than the noise level itself. The authors also suggested the direct impact of the boat was brief, that the behaviour of harbour porpoise was during exposure to prior to exposure was similar, and that normal behaviour resumed quickly (<50 s).
- 10.10.242 Similar responses and quick recovery times have also been observed in other species such as bottlenose dolphin (Lemon *et al.*, 2006; Ribeiro *et al.*, 2005). Wisniewska *et al.* (2018b) showed that despite potential short-term effects on foraging, harbour porpoise recovers quickly from vessel traffic and remain in areas of high traffic, even after diving as a response to fast ferries.
- 10.10.243 A reduction in harbour porpoise abundance was observed within a 5 km² area when there were more than 18 ships per km² (Heinänen and Skov, 2015). Benhemma-Le Gall *et al.* (2021) observed a reduction in harbour porpoise detections up to 4 km coincident with an increased level of activity from offshore wind related vessels. Likewise, Graham *et al.* (2019) found a greater potential for a behavioural response to offshore wind vessel activity within 1 km. Harbour porpoise is a species known to be sensitive to vessel presence and often shows avoidance behaviour; therefore, it is likely that other cetaceans would be displaced to a similar extent (or less).
- 10.10.244 Cetaceans can both be attracted to and displaced by vessels depending on context. For example, resting dolphins are likely to avoid vessels, foraging dolphins will ignore them, and socialising dolphins may approach vessels and 'bow-ride' (Richardson *et al.*, 1995). The level of any behavioural response can vary depending on circumstance, each study may represent a snapshot in time. Anderwald *et al.* (2013) showed that bottlenose dolphin presence was positively correlated with total number of vessels, but that minke whale and grey seal

were displaced by high levels of vessel traffic. A study by Richardson (2012) on the effect of disturbance on bottlenose dolphin community structure in Cardigan Bay, Wales, found that group size was significantly smaller in areas of high vessel traffic, and Watkins (1986) reported avoidance behaviour in mysticetes when approached by a boat.

- 10.10.245 Mikkelsen *et al.* (2019) recorded a change to the diving behaviour of a tagged grey seal, that switched rapidly from a dive ascent to descent in response to ship sound. Hastie *et al.* (2021) demonstrated how foraging context is important when interpreting avoidance behaviour in grey seal. In this study, avoidance rates appeared to depend on the perceived risk (e.g. silence, pile driving sound, operational sound from tidal turbines) versus the quality of the prey patch. Therefore, sound exposure in different prey patch qualities may result in markedly different behavioural response.
- 10.10.246 Joy *et al.* (2019) monitored a voluntary commercial vessel slowdown trial through 16 nm of shipping lanes which overlapped with critical habitat of southern resident killer whales. The disturbance metric used in this study was 'lost foraging time'. The slowdown trial achieved 22% reduction in 'potential lost foraging time' for killer whales (with 40% reductions when 100% of vessels were under the 11 knot speed limit).
- 10.10.247 Most vessels involved in the construction phase or the Proposed Development (with the exception of CTVs) are likely to be travelling considerably slower than 11 knots. With all vessels travelling at safe speeds at all times and to reduce speed when a marine mammal is in the vicinity, as detailed in the Outline NSVMP (Volume 4, Appendix 29: Outline Navigational and Vessel Management Plan; Table 10.30).
- 10.10.248 Pirota *et al.* (2015) found that the transit of vessels in the Moray Firth resulted in a reduction (by almost half) of the likelihood of recording bottlenose dolphin prey capture buzzes. The study also suggested that vessel presence, not just vessel sound, resulted in disturbance. A reduction in minke whale foraging activity was observed within an important feeding ground linked to the presence of whale-watching boats (Christiansen and Lusseau, 2015). Owen *et al.* (2024) monitored the long-term presence of harbour porpoises during the rerouting of the major shipping lane through the Kattegat into the Baltic Sea. Despite changes observed in vessel traffic and noise levels, no significant fluctuations were found in monthly presence or foraging behaviour. Wisniewska *et al.* (2018) found tagged porpoises did not appear to avoid highly trafficked areas, potentially because these overlapped with important foraging habitats (deep waters which may aggregate important prey items). It is likely in areas that important for foraging, animals are not displaced and chose instead to remain in an area with increase vessel activity.
- 10.10.249 Increased noise levels as a result of an increase in vessel traffic in an area could lead to altered vocalisation patterns. This has been observed in delphinids. Fouda *et al.* (2018) found that an increase in shipping resulted in simplified vocal calls. Dolphin whistles exhibited an upward shift in frequency content and with less complexity in the vocalisation. Bottlenose dolphins have been found to both increase and decrease whistle frequencies in noisy environments, thought

to acoustic masking and to improve signal transmission (Heiler *et al.*, 2016; La Manna *et al.*, 2013; May-Collado & Wartzok, 2008; Peters, 2018; Rako Gospić & Picciulin, 2016).

- 10.10.250 Evidence suggests that other characteristics of individual ship encounters in addition to noise and proximity, such as route predictability (steady vs. erratic paths) or speed may be relevant for the degree of disturbance (Baş *et al.*, 2015; Oakley *et al.*, 2017); therefore, marine mammals may be accustomed to regular and predictable transits such as those found in the Local Marine Mammal Study Area (see Paragraph 10.10.233, Figure 10.25) resulting in minimal additional disturbance.
- 10.10.251 There is therefore an observed tolerance to boat traffic (and anthropogenic sounds and activities in general) and so a slight increase from the existing levels of traffic in the vicinity of the Proposed Development may not result in high levels of disturbance (Vella I., 2001). Whilst it cannot be assumed that tolerance to vessel activity is evidence of absence of detrimental consequences (e.g. physiological responses are not easily detectable in free-ranging wild animals), there is evidence of animals (from multiple species) of persistence in areas of high vessel traffic. Furthermore, where displacement effects have been observed in relation to vessel presence, animals have been shown to quickly return to the areas in question.
- 10.10.252 The evidence for behavioural disturbance is highly context driven, and highlights that there are differences inter- and intra-species. The level of any behavioural response will depend on the activity of the individual exposed, how motivated they are to remain in the area, and their previous exposure to vessel activity. The evidence from scientific peer reviewed literature indicates whilst there might be an initial immediate avoidance behaviour as a result of vessels activity, animals would likely return to the area, and therefore vessel presence is unlikely to elicit a lasting effect of ongoing displacement.
- 10.10.253 Given the existing levels of vessel activity in the Shipping and Navigation Study area (see Paragraph 10.10.233 to 10.10.234), it is expected that marine mammals would tolerate the effects of any disturbance without any impact on reproduction and survival rates and would return to previous activities once the impact had ceased.
- 10.10.254 All species are deemed to have some resilience to behavioural disturbance, limited ability to avoid or adapt behaviour to the impact, and high recoverability. The sensitivity of the marine mammal receptor is therefore, considered to be medium.

Significance of the Effect

Auditory Injury

- 10.10.255 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

10.10.256 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.10.257 No Additional Mitigation is considered necessary, because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

O&M Phase

Magnitude of Impact

10.10.258 During the O&M phase of the Proposed Development, the increased levels of vessel activity will contribute to background subsea noise levels. The MDS for O&M activities associated with the Proposed Development assumes up to a total of 12 vessels to be present within the Proposed Development at any one time making up to 588 return trips over the duration of O&M phase (30 years). In addition to this, a further number of vessels will undertake another 146 return trips spread over entire 30-year O&M phase (Table 10.19).

10.10.259 The uplift in vessel activity during the O&M phase is considered to be relatively small in the context of the baseline levels of vessel traffic in the vicinity and within the Proposed Development (see 10.10.222 to 10.10.224). Presence of the operational wind farm may divert some of the vessel routes and therefore, current traffic within the Site Boundary, which is not associated with the Proposed Development, is likely to be reduced. It is likely that this reduction will ultimately be counterbalanced by presence of maintenance vessels. Vessel movements will be limited to within the Site Boundary and are likely to follow existing shipping routes to and from the ports. The designed in measures to reduce the behavioural disturbance to marine mammals, the Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) (Table 10.30) will be followed at all times.

10.10.260 The size and sound outputs from vessels during the O&M phase will be similar to those used in the construction phase and therefore will result in a similar MDS (Table 10.62; Table 10.63). However, the number of vessels and round trips is much lower for the O&M phase compared to the construction phase.

10.10.261 Embedded Mitigation measures adopted as part of the Proposed Development include the development of and adherence to an Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan), which includes adherence by vessels to guidelines laid out in the SMWWC (Table 10.30). The Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) will includes requirements to not deliberately approach marine mammals as a minimum, avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride and to remain at safe speeds at all times and reduce speed when a marine mammal is in the vicinity. Therefore, these measures will further reduce the potential risk of injury

or disturbance, and the scale of effect (impact radius and number of animals affected) was predicted to be very small.

Auditory Injury

10.10.262 An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities as well as associated effects (auditory injury) are described in Paragraph 10.10.219 *et seq.* for the construction phase and have not been reiterated here for the O&M phase of the Proposed Development.

10.10.263 The impact is predicted to be of local spatial extent, long-term term duration, intermittent and medium to low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Behavioural Disturbance

10.10.264 An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities, as well as associated effects (behavioural disturbance), is described in Paragraph 10.10.227 *et seq.* for the construction phase and has not been reiterated here for the O&M phase of the Proposed Development.

10.10.265 The impact is predicted to be of local spatial extent, long-term duration, intermittent and medium to low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low.

Sensitivity of the Receptor

Auditory Injury

10.10.266 The sensitivity of marine mammal receptors to auditory injury has been considered in detail in Paragraph 10.10.237 *et seq.*, and therefore is not reiterated here. Auditory injury ranges that are a result of vessels involved in the O&M phase (non-impulsive sound) are lower than auditory injury ranges for piling (impulsive sound) and the numbers of animals potentially injured (Table 10.63) are very low for all species.

10.10.267 Although auditory injury is considered to be a permanent reduction in hearing ability, all receptors are considered to be able to avoid or adapt behaviour, with some tolerance to the effect. The sensitivity of all receptors is therefore considered to be medium.

Behavioural Disturbance

10.10.268 The receptors' sensitivity during O&M is not expected to differ from that during the construction phase, which is described previously in Paragraph 10.10.239 *et seq.* and is deemed to be medium.

Significance of the Effect

Auditory Injury

- 10.10.269 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

- 10.10.270 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.271 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Decommissioning Phase

Magnitude of Impact

- 10.10.272 During the decommissioning phase of the Proposed Development, the increased levels of vessel activity will contribute in to background subsea noise levels. A Decommissioning Programme will be submitted to MD-LOT for consultation and approval and will be updated during the Proposed Development's lifespan to take account of changing best practice and new technologies. It is assumed there will be a range of vessels used for decommissioning activities such as removal of foundations, cables and cable protection (Table 10.19).
- 10.10.273 The MDS for decommissioning activities associated with the Proposed Development (Table 10.19) assumes that noise from vessels is likely to be the same as the vessel activity described for construction phase.

Auditory Injury

- 10.10.274 An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities as well as associated effects (auditory injury) are described in Paragraph 10.10.219 *et seq.* for the construction phase and have not been reiterated here for the decommissioning phase of the Proposed Development.
- 10.10.275 The impact is predicted to be of local spatial extent, long-term term duration, intermittent and medium to low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Behavioural Disturbance

- 10.10.276 An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities, as well as associated effects (behavioural disturbance), is described in Paragraph 10.10.237 *et seq.* for the construction phase and has not been reiterated here for the decommissioning phase of the Proposed Development.

10.10.277 It is likely that a similar measure to the Outline NSVMP will be adopted for the decommissioning phase, which will include adherence by vessels to guidelines laid out in the SMWWC (Table 10.30). Therefore, these measures will further reduce the potential risk of injury or disturbance, and the scale of effect (impact radius and number of animals affected) was predicted to be very small.

10.10.278 The impact is predicted to be of local spatial extent, medium-term duration, intermittent and medium to low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low.

Sensitivity of the Receptor

Auditory Injury

10.10.279 The sensitivity of marine mammal receptors to auditory injury has been considered in detail in Paragraph 10.10.237 *et seq.* and therefore is not reiterated here. Auditory injury ranges that are a result of vessels involved in the O&M phase (non-impulsive sound) are lower than auditory ranges for piling (impulsive sound) and the numbers of animals potentially injured (Table 10.63) are very low for all species.

10.10.280 Although auditory injury is considered to be a permanent reduction in hearing ability, all receptors are considered to be able to avoid or adapt behaviour, with some tolerance to the effect. The sensitivity of all receptors is therefore considered to be medium.

Behavioural Disturbance

10.10.281 The marine mammal receptors' sensitivity during decommissioning is not expected to differ from that during the construction phase, which is described previously in Paragraph 10.10.254 *et seq.* and is deemed to be medium.

Significance of the Effect

Auditory Injury

10.10.282 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

10.10.283 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.10.284 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

IMPACT 5: INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED BY WIND TURBINE OPERATION

- 10.10.285 During the O&M phase of the Proposed Development, there is a potential for Wind Turbine structures to generate underwater noise and therefore potentially cause injury and disturbance to marine mammals. Due to the limited data sources at the time of writing it is not possible to define a representative operational sound source level for use in modelling. As such, the operational sound from Wind Turbines have been assessed qualitatively (see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report).
- 10.10.286 This impact is relevant to the O&M phases of the Proposed Development and may cause indirect impacts to marine mammal receptors.

O&M Phase

Magnitude of Impact

Auditory Injury

- 10.10.287 For fixed foundations the main source of noise is derived from the moving mechanical parts in the nacelle (which is generally below 1 kHz in frequency). Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report highlights measurement data for operational wind farms is lacking, with few empirical investigations, and summarises the relevant literature available (Table 7.49 in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). The majority of studies at various wind farms (e.g. Horns Rev, North Hoyle, Scroby Sands, Kentish Flats, Barrow, Burbo Bank, (Ward *et al.*, 2006) Thorntonbank, Bligh Bank and Princess Amalia Wind Farm). Norro *et al.* (2011) concluded sound levels will be audible by marine mammal receptors, but not at a level that would cause injury or behavioural change (Betke, 2006; Botero-Bolívar *et al.*, 2025; Holme *et al.*, 2023; Jansen, 2016; Marmo *et al.*, 2013; Nedwell *et al.*, 2007; Norro *et al.*, 2011; Pangerc *et al.*, 2016; Ward *et al.*, 2006; Yoon *et al.*, 2023). Norro *et al.* (2011) reviewed a range of foundation and Wind Turbine types and found a slight increase in SPL compared to ambient noise measured prior to construction. Holme *et al.* (2023) found no significant relation between broadband underwater noise levels and Wind Turbine activity for any of the wind farms examined (up to 70 m) from Wind Turbines.
- 10.10.288 It should be noted however, that operational noise will be long-term (i.e. over the lifetime of the project) and there is very little understanding of this on marine species. Botero-Bolívar *et al.* (2025) modelled underwater aerodynamic (caused by the interaction between the turbulent wind and the Wind Turbine blades) noise footprints from 5 MW, 10 MW and 22 MW Wind Turbines and compared the subsea noise to hearing thresholds of marine mammals and scaled up the emissions for wind farms of both 100 and 150 Wind Turbines. Aerodynamic noise from the three Wind Turbine sizes affected the LF hearing group even when considering a single Wind Turbine, as a result of its longer propagating distance underwater (longer wavelengths), which means that the acoustic footprint of the Wind Turbines is larger for lower frequencies.

10.10.289 Although, existing empirical studies on operational noise from offshore wind of any foundation type are limited, there is a general consensus that the risk of injury to marine mammals from structure-borne noise (regardless of foundation type) is very low.

10.10.290 The impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. Given that animals are highly unlikely to stay within the injury ranges continuously for 24 hours, auditory injury leading to therefore population-level effects are highly unlikely to occur. The magnitude of impact is therefore considered to be negligible.

Behavioural Disturbance

10.10.291 The subsea noise from operational offshore Wind Turbines comes from vibration in the gear box and generator, which is transmitted down the tower and radiated from the tower wall. Limited though the existing studies are, both in number and in the number of turbines studied, they do agree that the risk to marine mammals and fish from subsea noise, both from the structure-borne noise expected from any offshore Wind Turbine, is low. Tougaard *et al.* (2009) recorded underwater noise from three Danish wind farms (at 450 kW, 500 kW, and 2 MW Wind Turbines) and found Wind Turbine sound detectable above ambient levels only below 500 Hz. SPL ranged from 109 dB re 1 μ Pa rms to 127 dB re 1 μ Pa rms at 14 m to 20 m. Harbour seal could perceive the sound up to 2.5 km to 10 km, while harbour porpoise up to 63 m. The study concluded the noise was unlikely to exceed injury thresholds or interfere with acoustic communication in either species. The upper bound for TTS derived in the Burns *et al.* (2022) study was found to be 80 m for VHF cetaceans (see Table 10.19). However, these findings are based on data collected for Wind Turbines with capacity between 2 MW to 5 MW and a hub height of up to 95 m. The MDS Wind Turbines for the Proposed Development are larger, (see Table 10.19) and therefore it is likely that there will be an increase of a few dB compared to smaller Wind Turbines. However, considering that the Proposed Development will be located in the North Sea with relatively high baseline shipping traffic (see Paragraph 10.10.216 *et seq.*), the difference in ambient sounds is anticipated to be minimal. Although noise levels are likely to be audible to marine mammals, animals are unlikely to experience behavioural disturbance including displacement as a result of the increased underwater noise during operational phase.

10.10.292 The impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Sensitivity of the Receptor

10.10.293 Whilst operational noise is continuous, it is unlikely that these noise levels would result in physiological damage (Madsen *et al.*, 2006; Marmo *et al.*, 2013; Tougaard *et al.*, 2009). Early measurements of underwater noise due to operational Wind Turbines concluded that the underwater noise from operating Wind Turbines is limited to low frequencies (below 1 kHz) and of low intensity and would therefore be unlikely to affect marine mammals with main hearing

sensitivities at higher frequencies (i.e. VHF and HF cetaceans and PCW) (Madsen *et al.*, 2006; New York State Energy Research and Development Authority, 2017; Thomsen *et al.*, 2015). Even so, behavioural responses by marine mammal species to operational Wind Turbine noise appears to be minimal. Modelled predictions by Marmo *et al.* (2013) suggested that only a small proportion (<10%) of minke whales and harbour porpoises would display behavioural responses up to ~18 km away from an OWF, and the majority of animals studied would not show a behavioural response, indicating low potential for displacement.

- 10.10.294 Monitoring using acoustic recordings (with T-PODs) at Horns Rev OWF in the North Sea revealed, whilst there was a weak adverse effect on harbour porpoise from the construction on porpoises, no detectable effects were observed on abundance from the operating wind farm (Tougaard *et al.*, 2006). It must be noted however there was a significant difference between when intensive maintenance work took place (termed ‘semi-operation’) in the study, and operation. Acoustic and ship survey data indicated more porpoises in the area as a whole during the operational period than for any other of the periods, baseline included.
- 10.10.295 However, field measurements and modelling efforts to estimate operational noise levels have predominantly focused on fixed-bottom OWFs in shallow, nearshore environments. Analysis of noise measurements from a Swedish (Bockstigen- Valar) fixed-bottom OWF, concluded that operational noise levels are unlikely to harm or mask acoustic communication in harbour porpoises and harbour seal (Tougaard *et al.*, 2009). Tougaard *et al.* (2009) reported at 100 m distance from 1.5 MW Wind Turbines, subsea noise would be audible to both harbour porpoise and harbour seal. However, at a greater distance of 1,000 m the signal to ambient sound ratio is too low for detection in harbour porpoise as a VHF cetacean (detection by harbour seal might be possible). Furthermore, the authors caveat these results, as ambient sound values used in this study were extrapolated from measurements obtained in the Baltic and the ambient sound in most parts of the North Sea is much higher and will decrease the radius of detection significantly. The study concluded that the sound is unlikely to exceed injury thresholds at any distance from the Wind Turbines and was considered incapable of masking acoustic communication by harbour porpoise.
- 10.10.296 Studies using long-term frequency data from wind farms with 5 MW Wind Turbines (Alpha Ventus, Germany) found that whilst operational sound can be identified, levels hardly exceed beyond ambient sound levels in areas near main shipping traffic routes negligible (Stöber and Thomsen, 2021). Therefore, marine mammals in high traffic areas may not be able to discern operational Wind Turbine sound from background levels. Analysis of individual frequencies predicted a correlation between SPLs and the operational status of the Wind Turbines as well as the wind speed, but the total impact of the operational sound was mostly negligible (Stöber and Thomsen, 2021). Stöber and Thomsen (2021) suggested that direct drive Wind Turbines can trigger behavioural reactions in marine mammals up to 1.4 km away, whilst Wind Turbines with gearboxes may elicit responses up to 6.3 km away. Nedwell *et al.* (2007) analysed measurements of subsea sound inside and outside of four different

OWFs in British waters and found operational sound levels were low and only exceeded background levels close to the Wind Turbines (<1 km).

10.10.297 Findings in Thomsen *et al.* (2024) reported PTS impact ranges extending up to 33 m from the Wind Turbine (10 MW and 20 MW fixed foundations). A study by Baldachini *et al.* (2025) aligns with this study, whereby they applied the auditory weighting functions of marine animals on the modelled operational sound of three floating OWFs (Baldachini *et al.*, 2024) planned in the Strait of Sicily, modelling a 6 MW floating Wind Turbine, to assess the potential acoustic impact of PTS, TTS and behaviour. The study determined, using older Southall *et al.* (2019) thresholds, that PTS SELs are exceeded within 40 m from the wind farm for LF cetaceans (e.g. minke whale). TTS is reached by the modelled SEL of all wind farms, at distances between <30 m and 70 m from the wind farm boundaries, in both months (February and August), for all hearing groups. PTS levels were almost never exceeded, with only two exceptions. For LF cetaceans, they are exceeded for all wind farms between 30 m and 40 m from the boundary. For phocid carnivores, they are exceeded within the same distances, except for Sicily South. It must be noted that PTS and TTS using the SEL metric represent exposure levels over 24 hours, and therefore it is highly unlikely for a mobile marine mammal to remain close to a wind farm for extended periods and thus experience auditory physical damage. Consequently, Baldachini *et al.* (2025) suggest that behavioural disturbance should be of greater concern than auditory injury. The study determined the behavioural disturbance threshold for LF cetaceans (100 dB re 1 μ Pa Lp, Italian guidelines) can be exceeded up to 68 km from the wind farm (Med Wind), up to bottom depth.

Auditory Injury

- 10.10.298 The sensitivity of marine mammal receptors to auditory injury is considered to be the same as (or less than) subsea noise generated during piling and is not reiterated here (Paragraph *et seq.* 10.10.38).
- 10.10.299 Marine mammals are deemed to be of medium adaptability (limited ability to avoid or adapt), medium resilience (limited tolerance), low recoverability and high international value. The sensitivity of all marine mammal receptors is therefore, considered to be medium.

Behavioural Disturbance

- 10.10.300 There is not a substantial amount of empirical information on responses of marine mammals to Wind Turbines, based on the information presented in Paragraph 10.10.291 *et seq.* it is likely that the sensitivity of marine mammal receptors to behavioural disturbance is less than as a result subsea noise during piling.
- 10.10.301 Marine mammals are therefore deemed to have the ability to avoid or adapt their behaviour, have some tolerance, with the ability to recover from any impact. The sensitivity of the marine mammal receptor is therefore, considered to be low.

Significance of the Effect

Auditory Injury

- 10.10.302 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

- 10.10.303 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be low. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.304 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

IMPACT 6: INJURY TO MARINE MAMMALS DUE TO COLLISION WITH VESSELS

- 10.10.305 Injury to marine mammals due to collision with vessels may arise due to vessel use during the installation of the Wind Turbines and OSPs, the installation and/or maintenance of IAC and the Offshore Export Cables. This impact is relevant to the construction, O&M and decommissioning phases of the Proposed Development and may cause direct impacts to marine mammal receptors.

Construction Phase

Magnitude of Impact

- 10.10.306 Vessel traffic associated with the Proposed Development has the potential to lead to an increase in vessel movements within the Local Marine Mammal Study Area. This increase in vessel movement could lead to an increase in interactions between marine mammals and vessels during offshore construction. Whilst a broad range of vessel types are involved in collisions with marine mammals (Laist *et al.*, 2001), vessels travelling at higher speeds pose a higher risk because of the potential for a stronger impact (Schoeman *et al.*, 2020). The severity of injury seems also to be a function of speed (Conn and Silber, 2013; Garrison *et al.*, 2025), e.g. Laist *et al.* (2001) reported among collisions with lethal or severe injuries, 89% of the 28 vessels investigated were moving at 14 kts or faster.
- 10.10.307 Collisions of vessels with marine mammals have the potential to result in both fatal and non-fatal injuries (Cates & Acevedo-Gutiérrez, 2017; Laist *et al.*, 2001; Vanderlaan & Taggart, 2007). Evidence for fatal collisions has been gathered from carcasses washing up on beaches, carcasses caught on vessel bows (Laist *et al.*, 2001; Peltier *et al.*, 2019) and floating carcasses. Injuries including propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific site, fractures and ship paint marks have strongly suggested ship strike as cause of injury (Douglas *et al.*, 2008; Jensen *et al.*, 2003). However, fatalities from ship strikes do often go unreported (Authier *et al.*, 2014). There is evidence of animals which have survived ship strikes with no discernible injury (non-fatal

injuries) and have been widely documented (Luksenburg and Parsons, 2014; Wells *et al.*, 2008).

- 10.10.308 Guidance provided by National Oceanic and Atmospheric Administration (NOAA) has defined serious injury to marine mammals as “*any injury that will likely result in mortality*” (NMFS, 2005). NMFS clarified its definition of ‘serious injury’ in 2012 and stated their interpretation of the regulatory definition of ‘serious injury’ as any injury that is “*more likely than not*” to result in mortality, or any injury that presents a greater than 50% chance of death to the marine mammal (Helker *et al.*, 2017; NMFS, 2023). In contrast, nonserious injury is likely to result in short-term impacts which may have long-term effects on health and lifespan.
- 10.10.309 Vessel traffic associated with the construction activities will result in an increase in vessel movements within the Local Marine Mammal Study Area, as up to 2,120 return trips by construction vessels may be made throughout the construction phase (1,671 return trips for the Array Area and 449 return trips on the Export Cable Corridor) (Table 10.19). This increase could lead to an increase in the likelihood of interactions between marine mammals and vessels. Vessels travelling at 7 m/s (~14 kts) or faster are those most likely to cause death or serious injury to marine mammals (Laist *et al.*, 2001; Wilson *et al.*, 2006). As detailed in Table 10.30, all vessels will be required to adhere to the Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) which includes not deliberately approaching marine mammals as a minimum, to avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride and to remain at safe speeds at all times and reduce speed when a marine mammal is in the vicinity, which is therefore appropriate to reduce risk of collision for species found within the Regional Marine Mammal Study Area as far as practicable. Therefore, with the Embedded Mitigation as part of the Proposed Development in place, the risk of collision is anticipated to be reduced and would only be present for transiting vessels (as opposed to stationary vessels, such as during piling).
- 10.10.310 A proportion of vessels involved in construction will be relatively small in size (e.g. tugs, guard vessels, survey vessels, support vessels, CTVs, UXO clearance vessels) and due to good manoeuvrability would be able to move to avoid marine mammals where detected (Schoeman *et al.*, 2020). Larger vessels such as cargo barges and installation vessels with lower manoeuvrability may need larger distances to avoid an animal, however they will also be travelling at slower speeds and have more time to react when a marine mammal is detected. Furthermore, as detailed in Paragraph 10.10.212, harbour porpoise were more likely to move further away from the boat path when approached at slower speeds than at faster speeds and therefore avoid collision risk.
- 10.10.311 In addition, the noise emissions from vessels involved in the construction phase are likely to deter animals from the potential zone of impact, as to some extent the sound from the vessels themselves (Paragraph 10.10.216 *et seq.*) would act antagonistically with this impact by deterring animals away from vessels and thereby further reducing the risk of injury due to collision. For example, Buckstaff (2004) demonstrated that bottlenose dolphins increased their rate of

whistle production at the onset of a vessel approach, and then decreased production during and after it had passed. This increased whistle production may be a tactic to reduce signal degradation to ensure that information is being communicated in elevated noisy environment, but it also demonstrates that animals are aware of approaching vessel from a distance. This corroborates the previous research of (Nowacek *et al.*, 2001) that found that bottlenose dolphins swim in tighter aggregated groups during vessel approaches. A more recent study by Pine *et al.* (2016) also discusses how vessel sound in addition to ambient sound levels mask communication in marine mammals, and more specifically reduced communication ranges of bottlenose dolphins by 26% within 50 m of the sound source. This impact may therefore increase avoidance behaviours of vessels (Pine *et al.*, 2016). Therefore, it is considered that, if a vessel is loud enough to be detected by an animal for which it adjusts its behaviour, the likelihood of collision decreases. Disturbance distances from vessel noise is discussed in Paragraph 10.10.239 *et seq.* in detail. Furthermore, the vessel movements will likely be contained within the Site Boundary or previous known routes of vessel movements.

10.10.312 With Embedded Mitigation, the Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) (Table 10.30), adopted as part of Proposed Development in place the likelihood of collision is reduced. The impact is predicted to be of very limited spatial extent, medium-term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive marine mammal receptors is of medium to low reversibility (depending on the extent of injuries).

10.10.313 Although a collision impact will affect the marine mammal receptor directly, it is considered unlikely to occur. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

10.10.314 In general, marine mammals are largely able to detect and avoid vessels in advance due to their hearing sensitivity, particularly when conducting activities such as seismic surveys (Koski *et al.*, 2009). Nevertheless, it remains unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman *et al.*, 2020) with analysis of data showing various interacting factors (e.g. ambient or background subsea noise) can interfere with the ability of marine mammals to detect approaching ships (Gerstein *et al.*, 2005). It has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels regardless of detection abilities (Dukas, 2002; Gerstein *et al.*, 2005). As such there can be consequences to this lack of response to disturbance for all marine mammals; behavioural habituation can result in decreased wariness of vessel traffic, which may result in an increased collision risk (Cates and Acevedo-Gutiérrez, 2017).

- 10.10.315 Vessels strikes are known to be a cause of mortality in marine mammals (Carrillo and Ritter, 2010), and it is possible that mortality from vessel strikes is under recorded (Van Waerebeek *et al.*, 2007), particularly for smaller marine mammals (Schoeman *et al.*, 2020). Collisions between vessels and large whales can often lead to death or serious injury (Kraus, 1990). Collisions between cetaceans and vessels are not necessarily lethal on all occasions (Van Waerebeek *et al.*, 2007). Although all types of vessels may hit whales, most lethal and serious injuries are caused by large ships (e.g. 80 m or longer) and vessels travelling at speeds faster than 14 kts (Laist *et al.*, 2001).
- 10.10.316 Given harbour porpoise, as the most abundant cetacean species in the Regional Marine Mammal Study Area, are small and highly mobile and considering their potential avoidance responses to vessel noise, it can be assumed that they will largely avoid vessel collisions. UK Cetacean Strandings Investigation Programme (CSIP) (CSIP, 2015) reported results of post-mortem analysis conducted on 53 harbour porpoise strandings in 2015. A cause of death was established in 51 examined individuals (approximately 96% of examined cases) and, of these, only four (8%) had died from physical trauma of unknown cause, which may have resulted from vessel strikes (CSIP, 2015).
- 10.10.317 Vessel strikes can result in lethal or non-lethal injuries to dolphins (Schoeman *et al.*, 2020). Olson *et al.* (2022) reported that evidence from long-term photo-identification data shows that only one out of a group of 277 bottlenose dolphin present within the study region exhibit marks indicative of vessel interactions. An earlier study by Van Waerebeek *et al.* (2007) reported that bottlenose dolphin is one of the species that may receive a moderate impact from collisions, however these may be sustainable at species level because many strikes are non-lethal.
- 10.10.318 However, collision risk for seals is less understood than for cetaceans. Trauma ascribed to collisions with vessels has been identified in <2% of both live stranded (Goldstein *et al.*, 1999) and dead stranded seals in the USA (Swails, 2005). A study in the Moray Firth, Scotland (Onoufriou *et al.*, 2016) showed that seals utilise the same areas as vessels during trips between haul-outs and foraging sites but that seals tended to remain beyond 20 m from vessels and only three instances over the 2,241 days of recorded seal activity resulted in passes at <20 m.
- 10.10.319 In the past five years of available annual SMASS reports (2023 to 2019) only three individuals; two short-beaked common dolphins *Delphinus delphis* and one harbour porpoise, were recorded within Scottish waters with physical trauma from boat or ship strike identified as the cause of mortality (Davison and Doeschate, 2020; SMASS, 2022; Brownlow *et al.*, 2023). In addition, of the available CSIP reports (2018 to 2022) UK waters, there were nine individuals identified as having boat/ship strike as the cause of mortality, all of which were cetaceans. One of these, a minke whale, was examined within the North Sea in Fife, Scotland (Deaville *et al.*, 2019; 2020; 2021; 2022; 2023). In comparison, within the SMASS reports the number of cetaceans which experienced a mortality from physical trauma from entanglement was much higher than that of boat/ship strike, reporting a total of 21 within Scotland (SMASS, 2020; 2022;

2023). This shows how few individuals within the Regional Marine Mammal Study Area have experienced lethal strikes by vessels.

10.10.320 Thus, on the basis that not all collisions that do occur are lethal, there is considered to be a medium potential for recovery. Necropsies and observations of whales surviving a vessel strike have provided information about the relationship between the severity of injury (e.g. depth of laceration, anatomical site of injury) and vessel speed (Combs, 2018; Conn and Silber, 2013; Rommel *et al.*, 2007; Vanderlaan and Taggart, 2007; Wiley *et al.*, 2016). Furthermore, factors such as interspecific differences in bone strength may result in different risks of incurring blunt force trauma (Clifton *et al.*, 2008) and provide further complex variability in lethality of collisions.

10.10.321 All marine mammals are deemed to have medium vulnerability (on the basis that marine mammals can display avoidance behaviour), medium recoverability (on the basis that not all collisions are fatal). The sensitivity of the marine mammal receptor is therefore considered to be medium.

Significance of the Effect

10.10.322 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the marine mammal receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.10.323 No Additional Mitigation is considered necessary, because the likely effect in the absence of further Additional Mitigation is not significant in EIA terms.

O&M Phase

Magnitude of Impact

10.10.324 Vessel use during O&M phase of the Proposed Development may lead to injury to marine mammals due to collision with vessels. Vessels will be associated with a range O&M activities, including routine inspections, repairs and replacements, removal of marine growth and painting.

10.10.325 Vessel types which will be required during the O&M phase may include vessels such as SOVs, CTVs, tug vessels, cable repair vessels, Dive Support Vessels (DSVs) and heavy lift vessels (Table 10.19). The types of vessels are similar to those presented for the MDS for the construction phase. An overview of the potential impacts due to vessel presence and associated effects (collision) are described in Paragraph 10.10.306 *et seq.* for the construction phase and have not been reiterated here for the O&M phase.

10.10.326 With Embedded Mitigation (the Outline NSVMP Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan (Table 10.30)) in place the likelihood of collision is reduced. The impact is predicted to be of very limited spatial extent, long-term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive marine mammal receptors is of medium to low reversibility (depending on the extent of injuries).

It is predicted that the impact will affect the receptor directly. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

10.10.327 The sensitivity of the marine mammal receptors during the O&M phase is not expected to differ from the sensitivity of the receptors during the construction phase (see Paragraph 10.10.314 *et seq.*). Therefore, the sensitivity of marine mammal receptors to collision risk is assessed as medium.

Significance of the Effect

10.10.328 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms

Additional Mitigation and Residual Effect

10.10.329 No Additional Mitigation is considered necessary, because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Decommissioning Phase

Magnitude of Impact

10.10.330 Vessel use during decommissioning phase of the Proposed Development may lead to injury to marine mammals due to collision with vessels. Vessels will be required for activities such as removal of foundation, cables and cable protection (Table 10.19). Noise from vessels is assumed to be as per vessel activity described for construction phase. An overview of the potential impacts due to vessel presence and associated effects (collision) are described in Paragraph 10.10.306 10.10.306 *et seq.* for the construction phase and have not been reiterated here for the decommissioning phase.

10.10.331 The impact is predicted to be of local spatial extent, medium-term duration, intermittent and medium to low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

10.10.332 The sensitivity of the marine mammal receptors during the decommissioning phase is not expected to differ from the sensitivity of the marine mammal receptors during the construction phase (see 10.10.314 *et seq.*). Therefore, the sensitivity of marine mammal receptors to collision risk is assessed as medium.

Significance of the Effect

10.10.333 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.10.334 No Additional Mitigation is considered necessary, because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

IMPACT 7: EFFECTS ON MARINE MAMMALS DUE TO ALTERED PREY AVAILABILITY

- 10.10.335 Potential effects on fish and shellfish during the construction, O&M and decommissioning phases of the Proposed Development, are detailed in Volume 2, Chapter 9: Fish and Shellfish Ecology. There is the potential for changes in availability or distribution of prey species as a result, which could affect the foraging ability of marine mammal species.
- 10.10.336 The key prey species for marine mammals include sandeels, gadoids (including cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus*), Scombridae (including Mackerel *Scomber scombrus* and Horse Mackerel *Trachurus trachurus*), clupeids (including sprat *Sprattus sprattus* and herring *Clupea harengus*) and Pleuronectiformes (including plaice *Pleuronectes platessa*). These prey species have been identified as being of regional or national importance within the Fish and Shellfish Ecology Study Area (Volume 2, Chapter 9: Fish and Shellfish Ecology).

Construction Phase

Magnitude of Impact

- 10.10.337 Potential impacts on marine mammal prey species during the construction phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology. Impacts on prey species include temporary habitat loss and disturbance, long-term habitat loss and disturbance, introduction of artificial habitat and subsequent colonisation of hard structures, increased SSCs and associated depositions, injury and/or disturbance to fish and shellfish from elevated subsea noise. The following paragraphs briefly summarise the conclusions of the Fish and Shellfish Ecology assessment, followed by an assessment of how this may impact marine mammal receptors.
- 10.10.338 The installation of Offshore Infrastructure within the Proposed Development will lead to temporary habitat loss/disturbance as a result of a range of activities including boulder and sandwave clearance, disturbance from IAC, Offshore Export Cables and interconnector cables, and use of jack-up vessels for the OSP installation. There is the potential for temporary habitat loss/disturbance to affect up to 19,414,805 m² of the seabed during the construction phase, which equates to 6.66% of the Proposed Development and represents a relatively small proportion of the Fish and Shellfish Ecology Study Area. Temporary habitat loss and disturbance has the potential to affect spawning, nursery or feeding grounds of fish and shellfish receptors, and therefore impact prey availability for marine mammals. Due to the highly localised nature of the effects (i.e. spatially restricted to within the Proposed Development) and the small proportion of habitats affected as a proportion of the northern North Sea and medium-term duration with recovery beginning immediately following cessation of the construction activity, temporary habitat loss/disturbance during the construction phase was assessed as being of low magnitude in Volume 2, Chapter 9: Fish and Shellfish Ecology.

- 10.10.339 Construction phase activities associated with the Proposed Development may lead to increased SSCs and associated deposition. During the construction phase, these activities will include drilling/piling for foundation installation, cable installation, sandwave levelling, trenchless technique installation (e.g. HDD exit pit excavation and drilling fluid release). Overall, the impact is predicted to be of local spatial extent, short-term duration, intermittent and high reversibility. (Volume 2, Chapter 9: Fish and Shellfish Ecology). The magnitude of impact is therefore considered to be low.
- 10.10.340 Piling of the foundations and OSP foundations could lead to injury and disturbance for fish and shellfish receptors during the construction phase of the Proposed Development. For peak SPL, the maximum recoverable injury range is estimated at 888 m to 1,389 m for the monopile foundations and 544 m to 882 m for a jacket. However, this is considered to be highly conservative due to the implementation of soft starts during piling activities, which will allow fish to move away from the areas of highest noise levels, before the received noise reaches a level that would cause an injury. As such, the maximum injury ranges predicted for soft start initiation (i.e. of the order of tens of metres) are likely to be more realistic. Using the SEL_{cum} metric, underwater noise modelling showed that injury may occur out to ranges of 10,430 m for monopile and out to 7,384 m for jacket. The impact is predicted to be of local spatial extent, short-term duration, intermittent over the construction phase and high reversibility, with the soundscape returning to near baseline conditions upon completion of piling. The magnitude of impact is therefore considered to be low (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.341 The mortality and potential mortal injury ranges for the low order clearance activities were modelled, based on peak SPL, to 81 m for all fish hearing groups, with these increasing to 910 m for high order clearance activities. The impact is predicted to be of local spatial extent, short-term duration during the site preparation activities, intermittent and high reversibility, with the soundscape returning to near baseline conditions upon completion of UXO clearance. The magnitude of impact is therefore considered to be low (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.342 Marine mammals forage over extensive distances and exploit a wide range of different prey items, with the ability to switch prey sources depending on season and availability. The impacts resulting from the construction of the Proposed Development on fish and shellfish receptors will be highly localised and largely restricted to the boundaries of the Proposed Development. In context of the wider available foraging habitat within the northern North Sea, the area of impact is very small.
- 10.10.343 On the basis of the assessments presented in Volume 2, Chapter 9: Fish and Shellfish Ecology, the magnitude of impact was low for fish and shellfish species as a result of the construction of the Proposed Development. Therefore, the resulting impact on marine mammals is predicted to be of a highly localised spatial extent, and the effect is anticipated to be temporary. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

- 10.10.344 The fish and shellfish communities found within the Fish and Shellfish Ecology Study Area (Volume 2, Chapter 9: Fish and Shellfish Ecology) are deemed to be characteristic of the fish and shellfish assemblages in the wider northern North Sea. It is considered highly likely that, considering the highly mobile nature of marine mammals, there will be similar prey resources available in the wider northern North Sea region.
- 10.10.345 Foraging over greater distances could result in an energetic cost with this effect being particularly pertinent for harbour porpoise. Harbour porpoise has a high metabolic rate and only a limited energy storage capacity, which limits their ability to buffer against diminished food. Despite this, if animals do have to travel further to alternative foraging grounds, the impacts are expected to be short-term in nature and reversible.
- 10.10.346 Minke whale has the potential to be vulnerable to potential effects on sandeels, particularly if there is a potential for reduced abundance. Studies analysing the stomach contents of minke whale found that in the North Sea this species is their key food resource, followed by Clupeidae and to a lesser extent mackerel (Robinson & Tetley, 2005; Tetley *et al.*, 2008). There are also high and low intensity spawning and nursery grounds for sandeel overlapping with the Proposed Development. However, Volume 2, Chapter 9: Fish and Shellfish Ecology concluded that all impacts for sandeels would be of minor adverse significance, which is not significant in EIA terms, therefore minke whale are not considered to be affected indirectly through impacts to sandeel.
- 10.10.347 All marine mammal receptors are deemed to be able to avoid or adapt behaviour, with some tolerance to altered prey availability, and able to recover. high resilience and adaptability. The sensitivity of all marine mammal receptors is therefore considered to be low.

Significance of the Effect

- 10.10.348 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the marine mammal receptor is considered to be low. The effect will, therefore, be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse significance, on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.349 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

O&M Phase

Magnitude of Impact

- 10.10.350 Potential impacts on marine mammal prey species during the O&M phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology. The assessment includes temporary habitat loss and disturbance, long-term habitat loss and disturbance, introduction of artificial habitat and subsequent colonisation of hard structures, increased SSCs and associated depositions, injury and/or disturbance to fish and shellfish from subsea noise, and impacts to fish and shellfish receptors due to EMF.

- 10.10.351 The MDS is for up to 11,688,813 m² of temporary habitat loss/disturbance during the O&M phase. This equates to 4.01% of the Proposed Development, which represents a very small proportion of the Fish and Shellfish Ecology Study Area. Up to 2,251,000 m² of long-term habitat loss representing 0.77% of the Proposed Development. Given that these impacts will be similar to those identified for temporary habitat loss/disturbance the construction phase (see Paragraph 10.10.338) and will be highly restricted to the immediate vicinity of these operations, the magnitude was assessed as low (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.352 During the O&M phase, subsea noise could arise from site-investigation surveys, vessel activity and Wind Turbine operations. These sources are expected to produce noise levels similar to or lower than those during construction, with impacts being very local, short-term, intermittent, and highly reversible. The overall risk to fish and other marine fauna from operational subsea noise is considered very low, with impacts being local, long-term, continuous at low levels, and reversible upon decommissioning, resulting in a low magnitude of impact (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.353 EMFs generated by up to 397 km of subsea electrical cables associated with the Proposed Development may have potential effects on fish and shellfish species. These EMFs, emitted from both buried and unburied cables, are strongest close to the source but decrease rapidly with distance, returning to background levels within a few to tens of metres. The majority of cables will be buried, which significantly reduces EMF exposure at the seabed, whilst unburied cables may expose species to higher EMF levels over short distances. However, due to the rapid attenuation of EMFs and the limited spatial extent of exposure, fish and shellfish are unlikely to experience significant behavioural changes or barrier effects. The impact on these species is therefore expected to be localised, long-term, intermittent (only occurring near the cables), highly reversible, and of low magnitude (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.354 During the O&M phase, the Proposed Development will maintain up to 2.34 km² of artificial hard structures on the seabed, including Wind Turbine and OSP foundations, scour protection and cable protection. These structures will persist throughout the 30 year operational lifespan. These structures introduce a hard substrate into the water column, although their exact surface area is not quantified due to design uncertainties. Whilst these structures are dispersed across the Proposed Development and not concentrated in one area, they represent a long-term, continuous alteration of the seabed environment. For fish and shellfish species, this results in a localised low magnitude of impact (Volume 2, Chapter 9: Fish and Shellfish Ecology).
- 10.10.355 The impact on marine mammals is predicted to be of limited spatial extent, and unlikely to occur. The magnitude of impact is therefore considered to be low.

Sensitivity of the Receptor

- 10.10.356 Marine mammals are highly mobile and wide-ranging, it is therefore expected that individuals could forage in alternative areas if required. However, Offshore Infrastructure (e.g. Wind Turbines) provides a hard substrate for the potential colonisation (Delefosse *et al.*, 2018) by various marine life. Faecal deposits from animals colonising structures, such as suspension feeders, likely alter the surrounding seafloor communities by increasing food availability in the Proposed Development (Degraer *et al.*, 2020). This increased food availability is likely to attract fish and marine mammals, who can exploit the increased foraging opportunities in the Proposed Development.
- 10.10.357 Species such as harbour porpoise, minke whale, white-beaked dolphin, harbour seal and grey seal have been frequently recorded around offshore oil and gas structures (Delefosse *et al.*, 2018; Lindeboom *et al.*, 2011; Todd *et al.*, 2015). A PrePARED study by Fernandez-Betelu *et al.* (2024) focussed on three OWFs concluded that the relationship between harbour porpoise occurrence and modelled sandeel distribution (the prey), may be moderated by offshore windfarm structures. Preliminary results from Fernandez-Betelu *et al.* (2024) indicated that harbour porpoises may change to other prey species which become more abundant within the offshore wind farm structures. Fernandez-Betelu *et al.* (2022) deployed an array of C-PODs within the vicinity of four offshore structures. The probability of porpoise occurrence and foraging activity was found to decrease with distance from offshore structures. These findings demonstrated that marine mammals are attracted to man-made structures (Fernandez-Betelu *et al.*, 2022). Acoustic results from a T-POD measurement within a Dutch wind farm found that relatively more harbour porpoises were found in the wind farm area compared to the two reference areas (Lindeboom *et al.*, 2011; Scheidat *et al.*, 2011). This study concluded that the presence within the wind farm area was due to increased food availability as well as the exclusion of fisheries and reduced vessel traffic in the wind farm. Further evidence suggesting that wind farms are used for foraging includes a study by Russell *et al.* (2014) where the movements of tagged harbour seal commonly exhibited grid-like movement patterns within two active wind farms in the North Sea.
- 10.10.358 Brandt *et al.* (2009) suggested, however, that a small increase in detections during the night at hydrophones deployed in close proximity to single Wind Turbines may indicate increased foraging behaviour near the monopiles. Whilst there is some mounting evidence of potential benefits of man-made structures in marine environment (Coolen *et al.*, 2020), the statistical significance of such benefits and details about trophic interactions in the vicinity of artificial structures and their influence on ecological connectivity remain largely unknown (Elliott and Birchenough, 2022; Inger *et al.*, 2009; McLean *et al.*, 2022; Rouse *et al.*, 2020).
- 10.10.359 Therefore, given the expected adaptability of marine mammals foraging ability, the sensitivity of the marine mammal receptor is considered to be low.

Significance of the Effect

- 10.10.360 Overall, the magnitude of the impact is deemed to be low, and the sensitivity of the marine mammal receptor is low. The effect will, therefore, be of Negligible or Minor adverse significance, the conclusion is **Minor** adverse significance, on a highly precautionary basis, (though could be minor beneficial for some species dependent on the reef effect (Volume 2, Chapter 8, Benthic Ecology: Section 8.10)), which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.361 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Decommissioning Phase

Magnitude of Impact

- 10.10.362 Potential impacts on marine mammal prey species during the decommissioning phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology. Overall, there were no significant environmental effects arising from the Proposed Development during decommissioning for fish and shellfish.
- 10.10.363 As the activities involved in decommissioning are broadly similar to construction activities, the magnitude of impacts is anticipated to be the same or less than for the construction phase. Therefore, the impact on marine mammals is predicted to be of a highly localised spatial extent, and the effect is anticipated to be temporary. The magnitude is therefore considered to be low.

Sensitivity of the Receptor

- 10.10.364 The sensitivity of marine mammal receptors during the decommissioning phase is not expected to differ from the sensitivity of the marine mammal receptors during the construction phase. The sensitivity of the marine mammal receptor is therefore, considered to be low.

Significance of the Effect

- 10.10.365 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the marine mammal receptor is low. The effect will, therefore, be of negligible or minor adverse significance, the conclusion is **Minor** adverse significance, on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.10.366 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

10.11 Inter-Related Effects

- 10.11.1 A description of the likely inter-related effects arising from the Proposed Development on marine mammals is provided in Chapter 21: Inter-Related Effects.

- 10.11.2 Inter-relationships are considered to be the impacts and associated effects of different aspects of Bowdun OWF on the same receptor. Inter-related effects are considered to be either:
- lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of Bowdun OWF (construction, O&M and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three project stages (e.g. underwater sound effects from piling, operational Wind Turbines, vessels and decommissioning); and
 - receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on Infrastructure and Other Users, such as displacement of recreational activities and impacts to cables or pipelines or restrictions on access to these assets, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short-term, temporary or transient effects, or incorporate longer-term effects
- 10.11.3 For marine mammals, the following potential impacts have been considered within the inter-related assessment:
- injury and disturbance from subsea noise generated during piling;
 - injury and disturbance from subsea noise generated during UXO clearance;
 - injury and disturbance from subsea noise generated during site-investigation surveys;
 - injury and disturbance from subsea noise generated by vessel use and other noise producing activities;
 - injury to marine mammals due to collision with vessels;
 - injury and disturbance from subsea noise generated by Wind Turbine operation; and
 - effects on marine mammals due to altered prey availability.
- 10.11.4 Table 10.64 lists the inter-related effects (project lifetime effects) that are predicted to arise during the construction, O&M phase, and decommissioning of the Proposed Development and also the inter-related effects (receptor-led effects) that are predicted to arise for marine mammal receptors.
- 10.11.5 As noted above, effects on marine mammals also have the potential to have secondary effects on other receptors and these effects are fully considered in the topic-specific chapters. These receptors and effects are:
- Fish and shellfish ecology: Changes in the marine mammal community could have indirect effects on fish and shellfish populations.

Table 10.64: Summary of Likely Significant Inter-Related Effects for Marine Mammals from Individual Effects Occurring Across the Construction, O&M and Decommissioning Phase of the Proposed Development (Project Lifetime Effects) and from Multiple Effects Interacting Across all Phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-Related Effects
	C	O&M	D	
Project Lifetime Effects				
Injury and disturbance from subsea noise generated during piling	✓	x	x	<p>Whilst subsea noise could occur during all phases of the Proposed Development, subsea noise generated during piling is limited to the construction phase only and therefore no likely significant inter-related effects across multiple phases of the Proposed Development from piling (project lifetime effects) are therefore predicted. Increased subsea noise during piling activities associated with construction of the Proposed Development has the potential to interact with other sources of underwater noise associated with the construction phase of the Proposed Development (such as UXO clearance).</p> <p>However, the subsea noise produced as a result of piling during construction of the Proposed Development is likely to reach over a larger area (e.g. up to 17,402 m for minke whale during the concurrent piling of two monopile foundations, Table 10.42) compared to other subsea noise producing activities associated with the Proposed Development and therefore during this phase it is considered unlikely that piling would act additively with other noise producing activities occurring at the same time, as the noise produced during piling is likely to mask other noise sources.</p> <p>Although piling itself occurs during only the construction phase, it would contribute to the overall temporal duration of subsea noise impacts across all phases of the Proposed Development and is discussed below in receptor-led effects.</p> <p>The significance of effect is considered to be minor adverse and therefore not significant in EIA.</p>
Injury and disturbance from subsea noise generated during UXO clearance	✓	✓	✓	<p>Whilst subsea noise could occur during all phases of the Proposed Development, increased subsea noise generated during UXO clearance is limited to the construction phase only and therefore no likely significant inter-related effects across multiple phases of the Proposed Development from UXO clearance (project lifetime effects) are therefore predicted. Increased subsea noise during UXO clearance during pre-construction activities could interact with other sources of subsea noise in the construction phase. This has the potential to contribute to an increase in the subsea noise which in turn could affect marine mammals. Low order clearance methods are the default, which has the potential to result in AUD INJ ranges of up to 1.27 km (Table 10.53) and localised disturbance out to 2.48 km (Table 10.56).</p> <p>However, the MDS assumes that high order clearance may occur, with potential for AUD INJ out to 14.23 km for the maximum assumed UXO size (720 kg NEQ) and out to 9.69 km for the most realistic maximum UXO size (227 kg NEQ). Disturbance (TTS as a proxy) may occur out to 34.28 km for the maximum assumed UXO size (720 kg NEQ) and out to 23.21 km for the most realistic maximum UXO size (227 kg NEQ). Additional disturbance is possible due to use of ADDs and soft start charges.</p> <p>It should be noted however, that for each UXO clearance, the duration of the impact – including mitigation techniques – will be very short, and there will be breaks between UXO clearance events to allow periods of recovery.</p> <p>It has however been concluded on a precautionary basis that temporally UXO clearance could add to the overall duration of elevated subsea noise from other activities during pre-construction (e.g. site-investigation surveys) and will contribute to the overall duration of subsea noise impacts throughout all phases of the Proposed Development and is discussed below in receptor-led effects.</p> <p>The significance of effect is considered to be minor adverse and therefore not significant in EIA.</p>
Injury and disturbance from subsea noise generated during site-investigation surveys	✓	✓	x	<p>Elevated subsea noise during site-investigation surveys could be additive over the construction and O&M phases of the Proposed Development with sequential noise from site-investigation surveys leading to extended effect on marine mammals. However, this impact will occur as short-term events with cessation of noise in between events allowing periods of recovery, and the impact is localised, maximum auditory injury range of 251 m (Table 10.58) and disturbance of 9.15 km (Table 10.60). Additive effects are possible (though unlikely given intermittency of surveys) and the duration of elevated underwater noise from all activities could be extended.</p> <p>The significance of effect is considered to be minor adverse and therefore not significant in EIA.</p>
Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	✓	✓	✓	<p>Elevated underwater noise during vessel use and other non-piling construction activities could occur across all three phases of the project. Vessels will be used throughout all stages of the Proposed Development and could cause additional disturbance to marine mammals.</p> <p>Other construction activities include drilling (foundation installation) and could also lead to disturbance effects in this phase.</p> <p>Auditory injury was not exceeded for all species, and disturbance effects are likely to be localised for non-piling construction activities and during vessel movements (e.g. out to maximum of 5,597 m) with breaks in activity within phases, however, temporally these effects could occur over all phases of the Proposed Development and lead to additive effects.</p> <p>The significance of effect is considered to be minor adverse and therefore not significant in EIA.</p>
Injury to marine mammals due to collision with vessels	✓	✓	✓	<p>Over the lifetime of the Proposed Development there will be an ongoing risk of collision associated with vessels throughout all phases. If injury to marine mammals from collisions did occur this could lead to losses of individuals, but it is unlikely to lead to population-level effects. The risk of mortality is likely to be low due to vessels moving at low speed, particularly by adopting good practice code of conduct for vessel operators (Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan, Table 10.30) and therefore the risks will be reduced.</p> <p>It is important to consider that, to some extent, the subsea noise from the vessels themselves would act antagonistically with this impact by deterring animals away from vessels and thereby further reducing the risk of injury due to collision.</p> <p>The significance of effect is considered to be minor adverse and therefore not significant in EIA.</p>

Description of Impact	Phase			Likely Significant Inter-Related Effects
	C	O&M	D	
Injury and disturbance from subsea noise generated by Wind Turbine operation	x	✓	x	This impact occurs during the O&M phase only, therefore no likely significant inter-related effects across multiple phases of the Proposed Development (project lifetime effects) are therefore predicted.
Effects on marine mammals due to altered prey availability	✓	✓	✓	Fish and shellfish communities may be affected through all phases of the Proposed Development and therefore could present a long-term effect on marine mammals through changes/reductions to prey availability. Inter-related effects on fish and shellfish receptors are described in more detail in Volume 2, Chapter 9: Fish and Shellfish Ecology. Volume 2, Chapter 9: Fish and Shellfish Ecology concluded that for all potential impacts and at all phases of the Proposed Development the effects were unlikely to lead to significant effects on fish and shellfish communities, and therefore unlikely to lead to significant effects on marine mammals (see Paragraph 10.10.335 <i>et seq.</i>). Even in the context of longer-term impacts there is unlikely to be an additive effect as marine mammals can exploit a suite of prey species and only a small area will be affected when compared to available foraging habitat in the northern North Sea. The significance of effect is considered to be minor adverse and therefore not significant in EIA.
Receptor-led Effects				
Stressor 1: injury or disturbance from elevated underwater noise (from piling, UXO clearance, site-investigation surveys, vessels, operational noise from Wind Turbines)	✓	✓	✓	<p>During the pre-construction phase, activities resulting in elevated subsea noise includes, UXO clearance, site-investigation surveys, vessel use and other noise producing activities. These activities are likely to result in disturbance to marine mammals which may be additive in nature if activities are synchronised, as it could lead to a larger area disturbed at any one time. Disturbance is likely to occur as short-term, localised events for each activity within the construction phase. Prior to piling, for example, UXO clearance could result in no more than 40 single clearance events (Table 10.19), with disturbance occurring mainly during Additional Mitigation (ADDs and soft start) rather than the UXO clearance event itself which would be no more than seconds for each. There is also a small potential that animals could experience injury during UXO clearance (if high order detonation is used). Site-investigation surveys will occur intermittently during the pre-construction phase, whilst disturbance during vessel activity will occur intermittently with timings linked to the pre-construction activities (UXO and site-investigation surveys).</p> <p>During the construction phase, activities resulting in elevated subsea noise include piling, other construction activities and vessel movements could occur. Since injury to marine mammals will be minimised through the MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) (Table 10.30), the key focus is on disturbance effects. Disturbance due to impact piling could occur intermittently on a total of 268 days over the construction phase of 60 months (five years). Other construction activities (e.g. drilling and cable laying) and vessel movements would occur intermittently within the five-year construction phase. When piling occurs the disturbance effects are likely to be greater than for any of the other activities contributing to elevated subsea noise so there is less likely to be an additive or synergistic effect during piling. Benhemma-Le Gall <i>et al.</i> (2021) found that piling was the main cause of displacement during construction with observed responses at distances of up to 10 to 15 km at Beatrice and Moray East OWFs and without piling, there was still a disturbance response due to vessel activity and other construction, but that the effect ranges (up to 4 km) were less compared to piling. This demonstrates that the main driver for disturbance will be piling and that there would be less potential for additive or synergistic, inter-related effects from other activities during this time. Indeed, the effect of piling may be antagonistic with effects from other sound-producing activities as it dominates the soundscape and therefore may ‘cancel out’ any other effects that could occur. There may, however, be an additive effect spatially where two or more noise producing activities occur in different parts of the Proposed Development (though this is highly unlikely), or temporally due to ongoing disturbance from activities throughout the construction phase (e.g. if they occur consecutively).</p> <p>During the O&M phase, activities resulting in elevated underwater noise include vessel activity, geophysical surveys and operational noise from Wind Turbines. These activities have the potential to result in disturbance to marine mammals which may be additive if activities are synchronised, as it could lead to a larger area disturbed at any one time. Disturbance is likely to occur as short-term, localised events for vessel activity (and it is likely other non-service vessels will be excluded from the OWF) and geophysical surveys and the disturbance from operational noise is expected to be highly localised and minimal. There may be a slight additive effect spatially where two or more noise producing activities occur in different parts of the Proposed Development, or temporally due to ongoing disturbance from activities throughout the O&M phase (e.g. if they occur consecutively).</p> <p>During decommissioning, vessel movements associated with decommissioning activities, as well as removal of foundations, cables and cable protection, will result in elevated underwater noise which could lead to disturbance to marine mammals. Disturbance is likely to occur as short-term, localised events and there may be an additive effect spatially where vessels are operating in different parts of the Array Area, or temporally due to ongoing disturbance throughout the decommissioning phase.</p> <p>Therefore, marine mammal receptors have the potential to experience ongoing disturbance due to elevations in underwater noise from different sources at all phases of the Proposed Development.</p> <p>The sensitivity of key species will be linked to their ability to tolerate the stressor such that their ability to function normally (e.g. forage, reproduce, communicate, avoid predators) is not impeded. The assessment, which adopts a highly precautionary approach has demonstrated that for all impacts, considered in isolation, the residual effects will not be significant, as either the spatial scale is very localised or where larger scale effects do occur (i.e. during piling or UXO) these will be highly reversible with animals returning to baseline levels rapidly.</p> <p>There are, however, uncertainties as to how all activities interact to contribute to an additive effect from underwater noise as a stressor. It is highlighted that the impact assessment adopted a conservative approach assuming the maximum extent of effects throughout each phase with no</p>

Description of Impact	Phase			Likely Significant Inter-Related Effects
	C	O&M	D	
				<p>allowance for any acclimatisation to, or compensation for elevated levels of sound. Whilst it is acknowledged that this approach is appropriate due to inherent uncertainties in undertaking such assessments, it may lead to overestimates of the effects.</p> <p>To some extent it is anticipated that animals will acclimatise to or compensate for such increases in underwater noise. Graham <i>et al.</i> (2019), for example, demonstrated acclimatisation in harbour porpoise, showing that the proportional response of harbour porpoise to piling noise decreased over the piling phase, with the proportion of animals disturbed at a received level of 160 dB re 1 µPa decreased from 91.5% to 49.2% from the first pile to the last pile. Kastelein <i>et al.</i> (2019) suggest that harbour porpoise (a species with high daily energy requirements) may be able to compensate for period of disturbance as they can dramatically increase their food intake in a period following fasting within out any detriment to their health. In the Moray Firth, buzzing activity of harbour porpoise (representing foraging) was higher compared to baseline levels during the construction of Moray East OWF, possibly in relation to increased prey availability as a result of introduction of hard substrates (e.g. jacket foundations and scour protection) (Benhemma-Le Gall <i>et al.</i>, 2021). Russell <i>et al.</i> (2014) demonstrated pinnipeds trace anthropogenic structures at sea, with three animals concentrating their foraging effort in the wind farms. Similarly, Rose <i>et al.</i> (2025) found significantly higher detection rates within OWFs than in their vicinity (surrounding 2.5 km), and suggested OWFs in operation may attract rather than deter harbour porpoise (due to reef and/or refugium effects). Therefore, significance is considered to be minor adverse and therefore not significant in EIA terms.</p>
Stressor 2: injury due to collisions with vessels	✓	✓	✓	<p>Injury due to collisions with vessels is associated with increased vessel movement, the impact of which was assessed from different types of vessels and at different phases of the Proposed Development. Over the lifetime of the Proposed Development there will be an increased temporal risk to marine mammal receptors however, with Embedded Mitigation such as the Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) (Table 10.30) the potential risk of injury due to collision is likely to be reduced and therefore it is not anticipated that an additive effect will occur. Additionally, to some extent the noise from the vessels themselves (Stressor 1) would act antagonistically with this impact by deterring animals away from vessels and thereby further reducing the risk of injury due to collision. Furthermore, marine mammals in this area are already accustomed to high level of vessel activity (see Paragraph 10.10.217 <i>et seq</i>). For example, Buckstaff (2004) demonstrated that bottlenose dolphins increased their rate of whistle production at the onset of a vessel approach, and then decreased production during and after it had passed. This increased whistle production may be a tactic to reduce signal degradation to ensure that information is being communicated in elevated noisy environment, but it also demonstrates that animals are aware of approaching vessel from a distance. This corroborates previous research of Nowacek <i>et al.</i> (2001) found that bottlenose dolphins swim in tighter aggregated groups during vessel approaches, therefore if a vessel is loud enough to be detected by an animal for which it adjusts its behaviour, the likelihood of collision decreases. Furthermore, not all collisions that do occur are lethal (e.g. dependent depth of laceration, anatomical site of injury, health of animal (Combs, 2018; Conn & Silber, 2013; Rommel <i>et al.</i>, 2007; Vanderlaan & Taggart, 2007; Wiley <i>et al.</i>, 2016) and is highly species dependent, and therefore the assessment precautionarily considered recovery potential to be medium from vessel collisions. Therefore, significance is considered to be minor adverse and therefore not significant in EIA terms.</p>
Stressor 3: changes in prey communities	✓	✓	✓	<p>The EIA considered overall effect on fish and shellfish communities from multiple stressors (see in Volume 2, Chapter 9: Fish and Shellfish Ecology) and therefore, in this respect, has taken an ecosystem-based approach. For some impacts stressors will be over the same timescales as marine mammals (such as underwater noise effects on fish and shellfish) whilst for others, such as temporary habitat loss, timescales may be different to those assessed for marine mammals (e.g. low mobility or sessile species may recover much more slowly). The assessment of effects (see Paragraph 10.10.335 <i>et seq.</i>) demonstrated that due to the high mobility of marine mammals, generalist feeding strategy and ability to exploit different prey species, combined with the small scale of potential changes in context of wider available foraging habitat for marine mammals, the changes to fish and shellfish communities are unlikely to have an effect even from multiple stressors. A recent study by (Watson <i>et al.</i>, 2024) reviewed the global impact of OWFs on ecosystem services and showed operational phase impacts were variable and detailed investigations into fish and shellfish recorded a net positive effect of wind farm operations on these species groups. Studies have found that the foundations of OWFs act as artificial reefs and fish aggregation devices (Degraer <i>et al.</i>, 2020; Langhamer, 2012) by providing space for the settlement, shelter and foraging (including pelagic and demersal fish and marine mammals). Equally, OWFs can act as a de-facto MPA by limiting activities that can negatively affect the environment, which can potentially enhance both biodiversity and fisheries in surrounding areas (Ashley <i>et al.</i>, 2014; Buyse <i>et al.</i>, 2022). Therefore, significance is considered to be minor adverse and therefore not significant in EIA terms.</p>
Multiple stressors: inter-related effect of all stressors	✓	✓	✓	<p>The inter-related effect of all stressors is discussed in detail in Paragraphs 10.11.6 to 10.11.15 below. The significance is considered to be minor adverse and therefore not significant in EIA terms.</p>

* Proposed Development Phase refers to construction (C), O&M (O) and decommissioning (D).

Multiple Stressors: Inter-related Effect of All Stressors

- 10.11.6 It is possible that multiple stressors interact across the lifetime of the Proposed Development. Arrigo *et al.* (2020) suggests that large organisms at higher trophic levels, such as marine mammals, may be generally negatively impacted by increasing interaction strength between stressors from different activities, but the variability in the response to such interactions is small and therefore unlikely to lead to population-level effects.
- 10.11.7 For elevated underwater noise there is the potential for marine mammals to forage in different habitats and to compensate for reduced foraging time. As such the ability of displaced animals will depend on the availability of prey resources in the habitat to which the animals are displaced. Studies have shown that for small, localised marine mammal populations with high site fidelity, there may be biological risks posed by displacement (Forney *et al.*, 2017). For example, due to the importance of the areas for survival (i.e. areas of high resource availability), animals may be highly motivated to remain in an area despite adverse impacts which may increase stress (Rolland *et al.*, 2012). Thus, the inter-related effects of underwater noise (Stressor 1) and changes in fish and shellfish prey resources (Stressor 3) needs to be considered. Impacts on fish and shellfish prey resources were predicted to be localised and short-term and therefore unlikely to contribute to an inter-related effect where animals are displaced beyond the boundaries of the Proposed Development. Within the boundaries of the Proposed Development however, there may be short-term inter-related effects of noise disturbance and reduced fish and shellfish prey resources. For marine mammals remaining in proximity to the Proposed Development, a substantial disruption in foraging may not be as easy to compensate for where there are shifts in the species composition or localised reductions of fish and shellfish communities. Gordon *et al.* (2003) suggested it may be possible that damaged or disoriented prey could attract marine mammals to an area of impact due to providing short-term feeding opportunities (but increasing levels of exposure), however, there is currently little evidence available to investigate such indirect effects on marine mammals.
- 10.11.8 Therefore, whilst the assessment has largely described potential adverse effects, there is also potential for some beneficial effects on marine mammal receptors. Construction of OWFs can lead to the introduction of hard substrates which can lead to the establishment of new species and new fauna communities, and this may in turn attract marine mammals (Fowler *et al.*, 2018; Lindeboom *et al.*, 2011; Raoux *et al.*, 2017). Thus, even where there is potential for an inter-related effect from ongoing vessel noise during the O&M phase this may be compensated for, to some extent, by an increase in available prey resources. Russell *et al.* (2014) and Russell and McConnell (2014) demonstrated that harbour seal and grey seal moved between hard structures at two operational wind farms and used space-state models to predict where animals were remaining at these locations to actively forage and where they were travelling to the next foundation structure.

- 10.11.9 Similarly, Rose *et al.* (2025) utilised 13 years of data from C-POD monitoring between 2010 and 2023, to carry out a comparison of harbour porpoise detection rates measured within OWFs in operation (positioned in the German Bight) to those in the vicinity of the same wind farm (2.5 km buffer). Results showed significantly higher detection rates within OWFs than in their vicinity, with an increase of 10.6% in the factor model. Rose *et al.* (2025) suggested operational OWFs may attract rather than deter harbour porpoises due to reef effects (offshore foundations and piles serve as a hard substrate and attract fish and other hard substrate-related fauna), as well as refugium effects (within the areas of German OWFs fishing is prohibited). Even though service vessels still operate within OWFs, and intrinsic ambient noise is present around the Wind Turbines, these impacts apparently did not deter harbour porpoises. Lindeboom *et al.* (2011) studied the ecological effects of the Egmond aan Zee OWF and found that even though the fish community was highly dynamic in time and space, with only minor effects upon fish assemblages observed during the O&M phase, some fish species (e.g. cod) benefited from the ‘shelter’ within the wind farm. This is likely due to reduced fishing activity and the new hard substratum with associated fauna which attracts predator species. Lindeboom *et al.* (2011) suggested the observed increase in echolocation activity of harbour porpoise within the wind farm may be correlated with presence of additional increased food sources compared to reference areas.
- 10.11.10 The potential inter-related effects between underwater noise and collision risk have been discussed previously (see Table 10.64) and it is considered likely that marine mammals will move away from moving vessels in response to engine noise, therefore reducing the risk of collision (classed as an antagonistic interaction). Alternatively, marine mammals may tolerate and persist in a highly stressed state (as a result of injury caused by underwater noise) whilst the vessels are approaching (Muto *et al.*, 2018). Animals could also become habituated to vessel noise and not move away from the vessel (McWhinnie *et al.*, 2018) which would result in a synergistic interaction (Wright & Weilgart, 2011). Therefore, the outcome will depend on the degree of habituation and prior experience and a number of acoustical properties that allow an approaching vessel to be detected by a marine mammal species (Gerstein *et al.*, 2005). However, as described in the impact assessment, with Embedded Mitigation in place (Table 10.30) it is likely that any risk of injury from collision with vessels will be negligible.
- 10.11.11 Evidence for the potential long-term effects of OWF on marine mammals (related to all potential stressors) comes from monitoring programmes which baseline levels of abundance to construction and post-construction (O&M) phases. Limited monitoring studies regarding impacts on marine mammals from OWF have been carried out to date.
- 10.11.12 Aerial survey Haul-Out counts were conducted before, during and after the construction phases at Scroby Sands OWF, off the coast of Norfolk, to monitor harbour and grey seal counts at haul-out site, located less than two kilometres away from the OWF array (Skeate *et al.*, 2012). A decline in harbour seal numbers was reported during construction, with numbers remaining lower over several

subsequent years. However, the numbers of grey seal increased dramatically year after year throughout the construction and early operational periods. It has been suggested that it is possible that changes in harbour seal numbers may be linked to rapid colonisation of competing grey seal (Skeate *et al.*, 2012). It was noted regional changes in patterns of haul-outs of harbour seal in the Wash coincided with the construction of the Scroby Sands OWF, but such changes in harbour seal number could have been part of wider regional dynamics (Verfuss *et al.*, 2016). It should be noted that Scroby Sands OWF is located 2.5 km off the coast of Great Yarmouth whereas the Proposed Development is located further (40.4 km from Firth of Tay and Eden Estuary SAC, designated for harbour seal) offshore and therefore a greater distance from haul-out sites. As a part of marine mammal monitoring at Robin Rigg OWF, boat-based surveys for cetaceans were conducted before, during, and after construction (Canning *et al.*, 2013). The monitoring data suggested that harbour porpoise were displaced from the wind farm site during the construction phase and operation period when compared to the pre-construction numbers. However, because there was only one year of pre-construction survey, natural variation cannot be ruled out as the reason for the observed change, especially since control survey locations outside of the wind farm also appeared to experience declines in harbour porpoise density.

- 10.11.13 With the rapid expansion of OWFs, post-construction monitoring programmes are being implemented at various developments in Europe. Tougaard *et al.* (2003) studied short-term effects of the construction of Wind Turbines on harbour porpoises at Horns Rev OWF and showed a decrease in porpoise acoustic activity within the wind farm at the onset of piling operations, but subsequent recovery to higher levels a few hours after each piling operation was completed. Tougaard *et al.* (2003) also showed that over the entire construction phase at Horns Rev there was no significant change in the abundance of harbour porpoise in the wind farm area compared to reference areas. Teilmann *et al.* (2008) also reported that during the O&M phase porpoise activity was higher in both the wind farm and reference area compared to baseline levels. As a result of monitoring at Nysted OWF, it was demonstrated initially during construction and the first two years of operation that there were lower acoustic detections of harbour porpoises in the wind farm area, with recovery starting to occur within two years after the end of construction (Teilmann *et al.*, 2006). Teilmann *et al.* (2006) suggested that animals were gradually habituating and returning to the wind farm area.
- 10.11.14 Nabe-Nielsen *et al.* (2011) suggested, using simulations of the response of harbour porpoise to wind farm construction, that wind farms already existing off Danish coast do not have impact on harbour porpoise population dynamics and that the construction of new wind farms is not expected to cause any changes in the long-term dynamics of the population. Likewise, Edrén *et al.* (2010) and McConnell *et al.* (2012) investigated possible interactions between seals and Danish OWF (Nysted Wind Farm and Rødsand II) and found that although there was a temporary reduction in the number of seals hauled out during construction operations (i.e. piling), there was no long-term effect on haul-out behaviour trends.

10.11.15 Therefore, the examples of monitoring studies suggest marine mammal receptors can quickly recover and return to the impacted area, despite the potential effects from multiple stressors associated with OWF. As such, the significance of multiple inter-related stressors is considered to be **Minor** adverse and therefore not significant in EIA terms.

10.12 Cumulative Effects Assessment

Methodology

- 10.12.1 Cumulative effects are defined as the effect of the Proposed Development in combination with the effects from a number of different projects, on the same receptor or resource. Further details on CEA methodology are provided in Volume 1, Chapter 6: Environmental Impact Assessment Methodology.
- 10.12.2 The projects selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 3, Technical Appendix 4.4: Cumulative Effects Assessment - Screening). Volume 3, Technical Appendix 4.4: Cumulative Effects Assessment - Screening provides further information in relation to other projects and how this information is obtained and applied to the assessment. Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.
- 10.12.3 A tiered approach has been adopted. This provides a framework for placing relative weight upon the potential for each project to be included in the CEA to ultimately be realised, based upon the project's current stage of maturity and certainty in the projects' parameters. The tiered approach which will be utilised within the Proposed Development CEA employs the following tiers:
- Tier 1 – The onshore elements of the Project;
 - Tier 2 – Projects that have an application submitted, are consented, under construction or operational to the extent not already captured with the baseline;
 - Tier 3 – Projects which have submitted a scoping report and/or have received a scoping opinion; and
 - Tier 4 – Reasonably foreseeable projects including those with Crown Estate Scotland option or lease agreements.
- 10.12.4 The specific projects scoped into the CEA for marine mammals, are outlined in Table 10.65 and Figure 10.26. Tier 1 encompasses only the onshore elements of the Project. There are not anticipated to be any receptor impact pathways for marine mammals between the onshore elements of the Project and the Proposed Development, therefore, there is no Tier 1 assessment included in the CEA for marine mammals.
- 10.12.5 The Regional Marine Mammal Study Area was used as a CEA screening buffer to identify relevant projects for assessment. The spatial and temporal scale of impacts is critical in the CEA and has been considered on an impact-by-impact

basis to ensure a proportionate approach to the CEA and is discussed in detail in Paragraph 10.12.8.

Table 10.65: List of Other Projects Considered Within the CEA for Marine Mammals

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
Tier 1						
There were no Tier 1 projects in the CEA long list brought forwards to the CEA marine mammals.						
Tier 2						
Offshore Wind Projects and Associated Cables						
Seagreen 1A Project	Consented	19.47	Seagreen 1A is made up of the 36 remaining Wind Turbines consented as part of the Seagreen 1 OWF. Seagreen 1A submitted a variation in consent to allow construction to take place between 2029 and 2032.	2029 - 2032 ³	2033 - 2057	The construction and O&M phases and potentially the decommissioning phases of the Seagreen 1A Project overlap with those of the Proposed Development.
Ossian OWF	Application submitted but not yet determined	25.36	The Ossian Floating Wind project is proposed for up to 265 floating wind turbines with a capacity of 3,600 MW. Operational lifetime 35 years.	2031 - 2038	2039 - 2073	The construction and O&M phases and potentially the decommissioning phases of the Ossian OWF overlap with those of the Proposed Development.
Berwick Bank OWF	Consented/Pre-construction	46.53	Berwick Bank OWF is proposed for up to 307 Wind Turbines with a capacity of up to 4,100 MW, with an operational lifetime of 35 years.	2027 - 2032	2033 - 2067	The construction and O&M phases and potentially the decommissioning phases of the Berwick Bank OWF overlap with those of the Proposed Development.
Muir Mhòr OWF	Application submitted but not yet determined	52.50	Muir Mhòr OWF is proposed for up to 67 Wind Turbine at a capacity of 798 MW.	2027 - 2030	2031 - 2055	Construction, O&M and potentially the decommissioning phases of the Muir Mhòr OWF overlap with those of the Proposed Development.
Salamander OWF	Consented	58.68	Salamander OWF is proposed for up to 100 MW.	2027 - 2029	2030 - 2054	The O&M and potentially the decommissioning phase of the Salamander OWF overlap with construction and O&M of the Proposed Development.
Aspen OWF	Application submitted but not yet determined	88.37	Floating OWF proposed for up to 1,000 MW and up to 72 Wind Turbines.	2027 - 2031	2032 - 2056	The construction, O&M and decommissioning phases of the Aspen OWF overlap with the construction and O&M Proposed Development.
MarramWind OWF	Application submitted but not yet determined	112.04	Proposed floating OWF for up to 147 wind turbines at a capacity of 3000 MW.	2030 - 2040	2041 - 2065	The construction, O&M and potentially the decommissioning phases of the Marram Wind OWF will overlap with those of the Proposed Development.
Caledonia OWF South	Application submitted but not yet determined	121.35	The South Site is proposed for up to 78 wind turbines with up to 140 wind turbines across the two sites (North and South). Caledonia Offshore Wind Farm (North and South) has an indicative generation capacity of 2,000 MW with an anticipated 35 years operational lifespan.	2028 - 2030	2031 - 2065	The construction, O&M and potentially the decommissioning phases of the Caledonia OWF South overlap with those of the Proposed Development.
Caledonia OWF North	Application submitted but not yet determined	136.29	The North Site is proposed for up to 77 wind turbines with up to 140 wind turbines across the two sites (North and South). Caledonia	2028 - 2030	2031 - 2065	The construction, O&M and potentially the decommissioning phases of the Caledonia

³ Seagreen 1A Project is a Tier 2 project and the construction dates have been amended since the initial CEA assessment with the construction phase now overlapping with the Proposed Development. However, according to the CEA methodology described in Volume 1, Chapter 4; Environmental Impact Assessment Methodology, this project has remained as part of the baseline within the CEA presented here for marine mammals.

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
			Offshore Wind Farm (North and South) has an indicative generation capacity of 2,000 MW with an anticipated 35 years operational lifespan.			OWF North overlap with those of the Proposed Development.
Cenos OWF	Application submitted but not yet determined	149.39	Proposed for up to 1,350 MW with up to 95 floating Wind Turbines.	2030 - 2034	2035 - 2059	The construction, O&M and potentially the decommissioning phases of the Cenos OWF overlap with those of the Proposed Development.
Culzean Floating Offshore Wind Turbine Pilot Project	Consented	185.50	Culzean Floating Offshore Wind Turbine Pilot Project aims to deploy one floating Wind Turbine with a capacity of 3 MW, test floater and mooring system technologies. The marine licence is being sought for a period of 10 years.	2026	2027-2036	The O&M phase of the Culzean Floating Offshore Wind Turbine Pilot Project overlap with construction and O&M of the Proposed Development.
Ayre OWF	Application submitted but not yet determined	192.87	Up to 1,000 MW with proposed up to 67 Wind Turbines.	2030 - 2034	2035 - 2059	The construction and O&M and potentially the decommissioning phases of the Ayre OWF overlap with construction and O&M of the Proposed
Dogger Bank South West	Application submitted but not yet determined	291.47	Dogger Bank South West is proposed for up to 100 Wind Turbines at a capacity of 1,500 MW.	2026 - 2030	2031 - 2055	The construction and O&M and potentially the decommissioning phases of the Dogger Bank South West overlap with construction and O&M of the Proposed Development.
Dogger Bank South East	Application submitted but not yet determined	316.71	Dogger Bank South East is proposed for up to 100 Wind Turbines at a capacity of 1,500 MW.	2026 - 2030	2031 - 2055	The construction and O&M and potentially the decommissioning phases of the Dogger Bank South East overlap with those of the Proposed Development.
Horns Rev II	Operational	562.60	The Horns Rev II OWF consists of up to 91 Wind Turbines at a capacity of 209.3 MW.	-N/A	2009 - 2034	The O&M and decommissioning phases of the Horns Rev II overlap with the construction and O&M phases of the Proposed Development.
Rønland OWF	Operational	574.88	Eight Wind Turbines with a capacity of 17.2 MW. Wind park established in 2003.	N/A	2003 - 2028	The decommissioning phase of Rønland OWF overlaps with the construction phase of the Proposed Development.
Alpha Ventus	Operational	592.28	Alpha Ventus consists of up to 12 Wind Turbines at a capacity of 60 MW. Potential for dismantle after 15 years of operation (news released March 2025) with no current decommissioning programme.	-N/A	2010 - 2035	The O&M and the decommissioning phases of the Alpha Ventus overlap with the construction and O&M phases of the Proposed Development.
Energy Park Vidar	Application submitted but not yet determined	728.67	Energy Park Vidar is proposed for up to 91 Wind Turbines with a capacity of 2,000 MW.	2027 - 2030	2031 - 2055	The construction, O&M and potentially the decommissioning phases of the Energy Park Vidar Project overlap with construction and O&M phases of the Proposed Development.
Mareld Floating OWF	Application submitted but not yet determined	728.67	Mareld OWF is consented for 2,500 MW. The project has received a Natura 2000 permit but is awaiting two more permits before the project can proceed.	2029 - 2031	2032 - 2056	The construction, O&M and potentially the decommissioning phases of the Merald Floating OWF Project overlap with those of the Proposed Development.
Poseidon Wind Power Project	Consented	728.67	Proposed 81 Wind Turbines with a capacity up to 1,400 MW. Permit for the construction and operation of the wind farm granted in	2029 - 2031	2032 - 2069	The construction, O&M and potentially the decommissioning phases of the Poseidon Wind Power Project overlap with those of the Proposed Development.

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
			November 2024. The permit is valid for 40 years from the start of the wind farm.			
Offshore Export Cable Routes and Carbon Capture and Storage						
Seagreen Phase 1A Offshore Transmission Owner (OFTO)	Consented	28.05	Consent includes an export cable approximately 110 km in length to a landfall location at Cockenzie.	2029 - 2032	2033 - Unknown	The construction, O&M and the decommissioning phases of the Seagreen Phase 1A OFTO overlap with the construction and O&M phases of the Proposed Development. The decommissioning phases may also overlap.
Inch Cape OFTO	Under construction	35.14	Two export cables with a capacity of 220 kV approximately 85 km in length between the landfall point at Cockenzie in East Lothian and the development area.	2025 - 2026	2027 - Unknown	The O&M and potentially the decommissioning phases of the Inch Cape OFTO overlap with the construction, O&M and potentially decommissioning phases of the Proposed Development.
Berwick Bank OFTO	Application submitted but not yet determined	46.53	Berwick Bank transmission is proposed for up to four cables.	2026 - 2029	2030 - Unknown	The O&M and potentially the decommissioning phases of the Berwick OFTO overlap with the construction, O&M and potentially decommissioning phases of the Proposed Development.
Caledonia OWF North Export Cable Route	Application submitted but not yet determined	96.84	The Caledonia North Offshore Export Corridor runs south through the Caledonia Site (North and South) to the landfall site at Stake Ness. Up to two export cables with maximum voltage of 275 kV and stretching up to 180 km.	2028 - 2030	2031 - Unknown	The O&M and the decommissioning phases of the Caledonia OWF North Export Cable Route overlap with the construction, O&M and potentially decommissioning phases of the Proposed Development.
Caledonia OWF South Export Cable Route	Application submitted but not yet determined	96.84	The Caledonia South Offshore Export Corridor runs south to the landfall site at Stake Ness. Up to two export cables with maximum voltage of 275 kV and stretching up to 150 km.	2028 - 2030	2031 - Unknown	The O&M and the decommissioning phases of the Caledonia OWF South Export Cable Route overlap with the construction, O&M and potentially decommissioning phases of the Proposed Development.
Moray West OFTO	Operational	146.79	Two export cables with a capacity of 132 - 400 kV.	-N/A	2025 - Unknown	The O&M and the decommissioning phases of the Moray West OFTO overlap with the construction, O&M and potentially the decommissioning phases of the Proposed Development.
Cables within 50 km of the Proposed Development						
Eastern Green Link 2	Under construction	0.00	2 GW subsea cable connecting Peterhead in Aberdeenshire and Drax in North Yorkshire. Onshore construction commenced in 2025. Offshore construction begins in 2027.	2025 - 2028	2029 - Unknown	The O&M phases of the Eastern Green Link 2 overlap with the construction and O&M of the Proposed Development. The decommissioning phases may also overlap.
Spittal to Peterhead High Voltage Direct Current (HVDC) Link Project	Under construction	62.49	Construction of a new 172 km, 2 GW, 525 kV subsea HVDC electricity transmission link in the Moray Firth. Marine licence granted 18 November 2025. Enabling works underway with main works starting in April 2026.	2026 - 2029	2030 - Unknown	The O&M phases of the Spittal to Peterhead HVDC Link Project overlap with the construction and O&M of the Proposed Development. The decommissioning phases may also overlap.

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
Tier 3						
Offshore Wind Projects and Associated Cables						
Morven North OWF	Pre-Application	10.03	Morven North OWF Array Project is proposed for up to 96 wind turbines at a capacity of 1500 MW. Application of relevant consents and licences expected in 2026 with decision in 2027.	2030 - 2036	2037 – 2061	The construction and O&M phases of the Morven North OWF Array overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Morven South OWF	Pre-Application	43.61	Morven South OWF Array Project is proposed for up to 95 wind turbines at a capacity of 1500 MW. Application of relevant consents and licences expected in 2026 with decision in 2027.	2030 - 2036	2037 – 2061	The construction and O&M phases of the Morven South OWF Array overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Bellrock OWF	Pre-Application	62.23	Bellrock OWF is proposed for a capacity of 1,800 MW with between 42 and 80 Wind Turbines.	2027 - 2030	2031 – 2055	The construction and O&M phases of the Bellrock OWF overlap with those of the Proposed Development.
Scaraben OWF	Pre-Application	125.19	Proposed between three and six wind turbines with a capacity of up to 99.5 MW.	2028 - 2029	2030 – 2054	The O&M and decommissioning phases of the Scaraben OWF overlap with construction and O&M of the Proposed Development.
Sinclair OWF	Pre-Application	128.11	Proposed between three and six wind turbines with a capacity of up to 99.5 MW.	2028 - 2029	2030 – 2054	The O&M and decommissioning phases of the Sinclair OWF overlap with construction and O&M of the Proposed Development.
Buchan OWF	Application submitted but not yet determined ⁴	131.73	Floating offshore wind farm is proposed for up to 70 floating Wind Turbines at a capacity of 1,000 MW. Project lifetime of 35 years.	2028 - 2030	2030 - unknown	The construction and O&M phases of the Buchan OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Stromar OWF	Pre-Application	153.38	Stromar is a proposed floating offshore wind farm for up to 1,500 MW capacity. Scoping Opinion issued April 2024.	2028 - 2032	2033 – 2057	The construction, O&M and decommissioning phases of the Stromar OWF overlap with construction and O&M of the Proposed Development.
Dogger Bank D	Pre-Application	319.71	Proposed wind farm with up to 122 Wind Turbines and a capacity of 2,000 MW. Up to four export cables making landfall south-east of Skipsea. Scoping report part 1 and 2 submitted June 2024. Application is expected to be submitted between July and September 2026.	2029 - 2034	2035 – 2059	The construction, O&M and decommissioning phases of the Dogger Bank D overlap with construction and O&M of the Proposed Development.
Arven OWF	Pre-Application	352.16	Arven is a 2,300 MW floating offshore wind development located to the east of the Shetland Islands. Scoping application for two array areas, Arven Array Area (360 km ²) and Arven South Array Area (100 km ²). Up to 161 Wind Turbines and eight export cables. Arven OWF is proposed for a capacity of 1800 MW.	2030 - 2034	2035 – 2059	The construction, O&M and decommissioning phases of the Arven OWF overlap with construction and O&M of the Proposed Development.

⁴ Buchan OWF is a Tier 2 project as of end of August 2025 as it is now in the planning phase with the Offshore EIA Report submitted. However, according to the CEA methodology described in Volume 1, Chapter 4; Environmental Impact Assessment Methodology, this project has remained assessed as a Tier 3 project within the CEA presented here for marine mammals.

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
Stoura Offshore Wind	Pre-Application	381.15	Stoura Offshore Wind Farm is proposed for up to 500 MW capacity from up to 40 wind turbines. Anticipated 35 years lifetime. Scoping Opinion issued October 2025.	2031 - 2035	2036 – 2070	The construction and O&M phases of the Stoura Offshore Wind overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Offshore Export Cable Routes and Carbon Capture and Storage						
Morven Hawthorn Pit Grid Connection Project	Pre-Application	1.81	Consists of the onshore and offshore infrastructure associated with the Morven OWFs. Up to six export cables with a capacity of 525 kV.	2029 - 2032	2033 – Unknown	The construction and O&M phases of the Morven Hawthorn Pit Grid Connection Project overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Ossian Transmission Infrastructure	Pre-Application	25.28	Up to six export cables with a maximum total length of offshore cable route of 509 km. Anticipated application submission in the latter half of 2026. Operational lifetime 35 years.	2030 - 2033	2034 - 2068	The construction and O&M phases of the Ossian Transmission Infrastructure overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Pipelines within 100 km of the Proposed Development						
Central North Sea Electrification (CNSE) Project	Pre-Application	36.00	Scoping request for the electrification of existing oil and gas infrastructure in the central North Sea. The infrastructure includes an onshore convertor station, an offshore convertor station, 66 kV offshore cabling connecting CNSE assets, 80 kV cabling to landfall, and 80 kV cabling from landfall to the onshore convertor station. Scoping Report submitted in May 2023.	2027 – 2028	2029 - Unknown	The O&M phases of the CNSE Project overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Eastern Green Link 5 (EGL5)	Pre-Application	72.20	EGL5 is a new primarily offshore high voltage electricity link between Scotland and England. Approximately 555 km of subsea HVDC cable from the Lincolnshire coastline to Scotland. Cable landfall in Scotland to be confirmed.	2030 - 2034	2035 - Unknown	The construction and O&M phases of the EGL5 overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Coastal						
Fraserburgh Harbour Development	Pre-Application	78.98	Proposed works to existing harbour improvement and construction of New South Harbour. Proposed works include relocation of existing south breakwater box berth, dredging and widening of the entrance of two harbours, a jetty and a pier, installation of pontoons and dredging the existing channel, extension of breakwater, installation of new breakwater, dredging and installation of new dry dock.	2028 - 2032	2033 - Unknown	The construction and O&M phases of the Fraserburgh Harbour Development overlap with those of the Proposed Development. The decommissioning phases may also overlap.

Project	Status	Distance from Proposed Development (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation	Overlap with the Proposed Development
Tier 4						
Offshore Wind Projects and Associated Cables						
Cedar OWF	Pre-Planning	104.26	Cedar OWF is proposed for up to 1,008 MW. Anticipating 50 plus years of operations.	2026 - 2027	2028 - 2077	The O&M phases of the Cedar OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Beech OWF	Pre-Planning	189.50	Floating wind farm for up to 1,008 MW. Anticipating 50 plus years of operations.	2026 - 2027	2028 - 2077	The O&M phases of the Beech OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Jyske Banke Nord	Planned	460.32	Proposed 1,100 MW in the North Sea, Denmark.	2027 - 2030	2031 - 2055	The construction, O&M and decommissioning phases of the Jyske Banke Nord overlap with construction and O&M of the Proposed Development.
Dreekant	Planned	507.90	Dreekant OWF is proposed at a capacity of 1,000 MW.	2030 - 2031	2032 - 2056	The construction, O&M and decommissioning phases of the Dreekant Project overlap with construction and O&M of the Proposed Development.
Nordsee Energies 3	Planned	508.67	Nordsee Energies 3 OWF is proposed for up to 10 Wind Turbines at a capacity of 1,000 MW.	2030 - 2031	2032 - 2056	The construction, O&M and decommissioning phases of the Nordsee Energies 3 Project overlap with construction and O&M of the Proposed Development.
Nordsee Energies 1	Planned	509.30	OWF is proposed for a capacity of 2,000 MW.	2028 - 2030	2031 - 2055	The construction, O&M and decommissioning phases of the Nordsee Energies 1 Project overlap with construction and O&M of the Proposed Development.
Nordsee Energies 2	Planned	516.40	OWF is proposed for a capacity of 1,500 MW.	2029 - 2031	2032 - 2056	The construction, O&M and decommissioning phases of the Nordsee Energies 2 Project overlap with construction and O&M of the Proposed Development.
Windbostel West (N-9.2)	Planned	516.60	N-9.2 OWF is proposed for a capacity of 2,000 MW. Expected commissioning 2031.	2030 - 2031	2032 - 2056	The construction, O&M and decommissioning phases of the Windbostel West overlap with construction and O&M of the Proposed Development.
Windbostel Ost (N-9.1)	Planned	517.45	N-9.1 OWF is proposed for a capacity of 2,000 MW.	2029 - 2030	2031 - 2055	The construction, O&M and decommissioning phases of the Windbostel Ost overlap with construction and O&M of the Proposed Development.
Nordsøen I - A2	Planned	530.39	Wind farm is currently out to tender with bid deadline in 2026. Planning and environmental impact report anticipated to start in 2026. Capacity of up to 1,000 MW.	2028 - 2032	2033 - 2057	The construction, O&M and decommissioning phases of the Nordsøen I - A2 Project overlap with construction and O&M of the Proposed Development.
Nordsøen I - A1	Planned	540.27	Wind farm is currently out to tender with bid deadline in 2027. Planning and environmental impact report anticipated to start in 2027. Capacity of up to 1,000 MW.	2028 - 2033	2034 - 2058	The construction, O&M and decommissioning phases of the Nordsøen I - A1 Project overlap with construction and O&M of the Proposed Development.

* Project Phase refers to construction (C), O&M (O) and decommissioning (D).

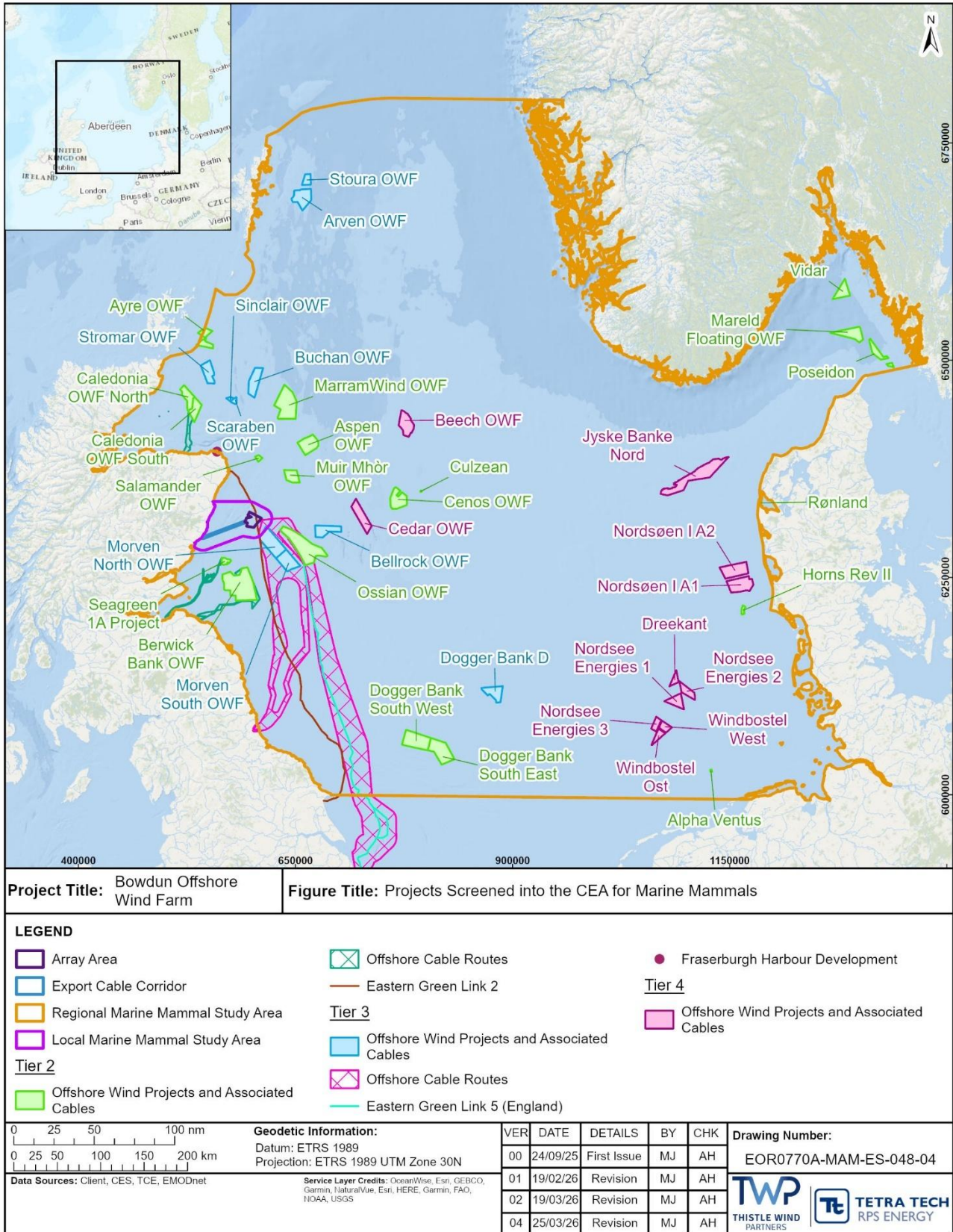


Figure 10.26: Projects Screened into the CEA for Marine Mammals

Maximum Design Scenario

- 10.12.6 The MDS identified in Table 10.66 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the details provided in Volume 1, Chapter 3: Project Description as well as the information available on other projects (see Volume 3, Technical Appendix 6.4: Cumulative Effects Assessment – Screening), to inform a ‘MDS’. Any other development scenario within the PDE, will result in in the same, or less, level of environmental effect.
- 10.12.7 Where there was no spatial or temporal overlap with the activities during certain phases of the Proposed Development, impacts associated with other projects listed in Table 10.66 have been excluded from further consideration.
- 10.12.8 During the initial CEA screening exercise for marine mammals, projects were identified within the Regional Marine Mammal Study Area. The identified projects were then further refined depending on the scale of each potential impact. For the purposes of the MDS for the CEA, projects have been screened in and out on the following basis per impact:
- **Injury and disturbance from subsea noise generated during piling** (Construction phase) – the ZoI for piling can extend beyond the boundaries of proposed OWFs and therefore, adopting a precautionary approach, the assessment has screened in projects within the Regional Marine Mammal Study Area whose construction phases overlap with the construction phase of the Proposed Development (2031 to 2036, with piling occurring between 2031 and 2033). Further, projects whose construction phase finishes in the one year preceding the commencement of piling at of the Proposed Development (which commences in 2031 and finishes in 2033) were also included, as the sequential piling at respective projects could lead to a longer duration of effects and whilst these projects are likely to be operational, this allows for potential delays in offshore construction (up to three years).
 - **Injury and disturbance from subsea noise generated during UXO clearance** (Construction phase) – the ZoI for UXO clearance can extend beyond the boundaries of other proposed OWFs. Therefore, adopting a precautionary approach, the assessment has screened in projects within 100 km of the Array Area and/or the Export Cable Corridor (which is greater than the largest disturbance range of ~34 km for the Proposed Development alone, and acknowledges that disturbance ranges from other projects may be substantial) whose construction phases (which would include pre-construction UXO clearance) overlap with the construction phase for the Proposed Development (2031 to 2036, with UXO clearance anticipated in 2031).
 - **Injury and disturbance from subsea noise generated during site-investigation surveys** (Construction and O&M phases) – it is anticipated that the magnitude of the impacts will be of a similar scale to that described for the Proposed Development (i.e. tens to low hundreds of

metres for auditory injury up to a maximum of 9.15 km for behavioural disturbance), with the potential to experience disturbance by marine mammal receptors expected to be localised to within the boundaries of the respective projects. Therefore, the CEA has focused only on those projects within the close vicinity (up to 50 km buffer) of the Array Area and/or Export Cable Corridor, and whose construction phase temporally overlaps with that of the Proposed Development (2031 to 2036, with site-investigation surveys expected in 2031).

- **Injury and disturbance from subsea noise generated by vessel use and other noise producing activities** (All phases) – it is expected that each project will contribute to the increase of vessel traffic and hence to the amount of vessel noise in the environment during all phases. However, the potential to experience disturbance by marine mammal receptors would be expected to be localised to within the close vicinity of the respective projects (for example the maximum disturbance range from vessels for the Proposed Development was 5.6 km) and as such the CEA has focused only on projects within a 50 km buffer of the Array Area and/or Export Cable Corridor as a precautionary approach.
- **Injury to marine mammals due to collision with vessels** (All phases) – it is expected that each project will contribute to the increase of vessel traffic and hence to the potential risk of collision during all phases. However, the potential to experience disturbance by marine mammal receptors would be expected to be localised to within the close vicinity of the respective projects and as such the CEA has only focused on projects within a 50 km buffer of the Array Area and/or Export Cable Corridor as a precautionary approach.
- **Injury and disturbance from subsea noise generated by Wind Turbine operation** (O&M phase) – this impact has included OWF projects whose O&M phases overlap with that of the Proposed Development. However, the potential to experience injury and disturbance by marine mammal receptors would be expected to be localised, and as such the CEA has focused only on OWF projects within a 50 km buffer of the Array Area as a precautionary approach. Risch *et al.* (2023) highlighted the importance of considering the cumulative noise output of large OWFs, particular where boundaries overlap, and therefore the wider 50 km buffer captures this wider spatial scale of potential effect.
- **Effects on marine mammals due to altered prey availability** (All phases) – potential cumulative effects on fish and shellfish assemblages, as identified in Volume 2, Chapter 9: Fish and Shellfish Ecology, may have indirect effects on marine mammals. Cumulative effects for fish and shellfish have been assessed within a representative 50 km buffer of the Site Boundary for all impacts except subsea noise, where a larger buffer of 100 km was used. Therefore, only the projects considered in Volume 2, Chapter 9: Fish and Shellfish Ecology are included.

10.12.9 The CEA presented in this marine mammal chapter has been undertaken on the basis of information presented in the Offshore EIA Reports for the other projects, which is based upon their respective MDS. The level of potential cumulative impact on marine mammals would likely be reduced significantly from those presented here.

Table 10.66: MDS Considered for Each Impact as Part of the Assessment of Likely Significant Cumulative Effects on Marine Mammals

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
Injury and disturbance from subsea noise generated during piling	✓	x	x	<p>The MDS is as detailed for the Proposed Development alone in Table 10.19, cumulatively with the following projects:</p> <p>Tier 1 No projects identified.</p> <p>Tier 2 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Ossian OWF (construction phase); • Berwick Bank OWF (construction phase); • Muir Mhòr OWF (construction phase); • Aspen OWF (construction phase); • MarramWind (construction phase); • Caledonia OWF South (construction phase); • Caledonia OWF North (construction phase); • Cenos OWF (construction phase); • Ayre OWF (construction phase). • Dogger Bank South West (construction phase); and • Dogger Bank South East (construction phase). <p>Tier 3 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Morven North OWF Array (construction phase); • Morven South OWF Array (construction phase); • Bellrock OWF (construction phase); • Buchan OWF (construction phase); • Stromar OWF (construction phase); • Dogger Bank D (construction phase); • Arven OWF (construction phase); and • Stoura Offshore Wind (construction phase). 	<p>As detailed in Paragraph 10.12.8, the Regional Marine Mammal Study Area was used to screen in projects from the CEA long list into the CEA for this impact. As piling will occur in the construction phase, projects within the Regional Marine Mammal Study Area whose construction phases overlap with the one year prior to the construction phase and the construction phase of the Proposed Development (2031 to 2036 within piling occurring between 2031 and 2033) have been included.</p> <p>Energy Park Vidar, Merald Floating OWF and Poseidon Wind Power Project are Tier 2 projects however, these do not have the required quantitative information available for the purposes of the CEA and therefore have been excluded on the basis of low data confidence. In addition, these projects fall outside of UK waters and are located at distances of 728.67 km from the project.</p>

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
				<u>Coastal</u> Fraserburgh Harbour Development (construction).	
Injury and disturbance from subsea noise generated during UXO clearance	✓	×	×	The MDS is as detailed for the Proposed Development alone in Table 10.19 cumulatively with the following projects: Tier 1 No projects identified. Tier 2 <u>Offshore Wind Projects and Associated Cables</u> <ul style="list-style-type: none"> • Ossian OWF (construction phase); • Berwick Bank OWF (construction phase); and • Aspen OWF (construction phase). Tier 3 <u>Offshore Wind Projects and Associated Cables</u> <ul style="list-style-type: none"> • Morven North OWF Array (construction); and • Morven South OWF Array (construction phase). <u>Offshore Export Cable Routes and Carbon Capture Storage</u> <ul style="list-style-type: none"> • Morven Hawthorn Pit Grid Connection Project (construction); and • Ossian Transmission Infrastructure (construction). Tier 4 No projects identified.	As detailed in Paragraph 10.12.8, a precautionary buffer of 100 km from the Array Area and/or the Export Cable Corridor was used to screen in projects from the CEA long list into the CEA for this impact. The projects screened in are those whose construction phases (which would include pre-construction UXO clearance) overlap with the construction phase for the Proposed Development (2031 to 2036, with UXO clearance anticipated in 2031).
Injury and disturbance from subsea noise generated during site-investigation surveys	✓	✓	×	The MDS is as detailed for the Proposed Development alone in Table 10.19, cumulatively with the following projects: Tier 1 No projects identified.	As detailed in Paragraph 10.12.8, a precautionary buffer of 50 km from the Array Area and/or Export Cable Corridor was used to screen in projects from the CEA long list into the CEA for this impact. Projects where site-investigation surveys have already been completed and no further surveys are

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
				<p>Tier 2 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Ossian OWF (construction and O&M phases); and • Berwick Bank OWF (construction and O&M phases). <p>Tier 3 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Morven North OWF Array (construction and O&M phases); and • Morven South OWF Array (construction and O&M phases). <p><u>Offshore Export Cable Routes and Carbon Capture Storage</u></p> <ul style="list-style-type: none"> • Morven Hawthorn Pit Grid Connection Project (construction and O&M phases); and • Ossian Transmission Infrastructure (construction and O&M phases). <p>Tier 4 No projects identified.</p>	<p>proposed (e.g. Westray South Tidal Farm (Orbital Marine Power, 2023)) have been excluded from the CEA. In addition, projects which will already be constructed by the construction phase of the Proposed Development (2027 to 2034) and have not assessed site-investigation surveys during their O&M phase have also been excluded (e.g. Pentland Floating OWF (Pentland Floating OWF, 2022)).</p>
Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	✓	✓	✓	<p>The MDS is as detailed for the Proposed Development alone in Table 10.19, cumulatively with the following projects:</p> <p>Tier 1 No projects identified.</p> <p>Tier 2 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Ossian OWF (all phases); and • Berwick Bank OWF (all phases). 	<p>As detailed in Paragraph 10.12.8, a precautionary buffer of 50 km from the Array Area and/or Export Cable Corridor was used to screen in projects from the CEA long list into the CEA for this impact.</p>

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
				<p><u>Offshore Export Cable Routes and Carbon Capture Storage</u></p> <ul style="list-style-type: none"> • Seagreen Phase 1A OFTO (O&M and decommissioning phases); • Inch Cape OFTO (O&M and decommissioning phases); and • Berwick Bank OFTO (O&M and decommissioning phases). <p><u>Cables within 50 km of the Proposed Development</u></p> <ul style="list-style-type: none"> • Eastern Green Link 2 (O&M and decommissioning phases). <p>Tier 3</p> <p><u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Morven North OWF Array (all phases); and • Morven North OWF Array (all phases). <p><u>Offshore Export Cable Routes and Carbon Capture Storage</u></p> <ul style="list-style-type: none"> • Morven Hawthorn Pit Grid Connection Project (construction and O&M phases); and • Ossian Transmission Infrastructure (construction and O&M phases). <p><u>Pipelines within 100 km of the Proposed Development</u></p> <ul style="list-style-type: none"> • CNSE Project (O&M phases only) <p>Tier 4 No projects identified.</p>	
Injury and disturbance from subsea noise generated by Wind Turbine operation	x	✓	x	<p>The MDS is as detailed for the Proposed Development alone in Table 10.19, cumulatively with the following projects:</p> <p>Tier 1 No projects identified.</p>	<p>As detailed in Paragraph 10.12.8, a precautionary buffer of 50 km from the Array Area was used to screen in floating OWFs from the CEA long list into the CEA for this impact. The Tier 2 and Tier 3 projects detailed in the previous column have been</p>

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
				<p>Tier 2</p> <ul style="list-style-type: none"> Ossian OWF (O&M phases); and Berwick Bank OWF (O&M phases). <p>Tier 3</p> <ul style="list-style-type: none"> Morven North OWF Array (O&M phases); and Morven South OWF Array (O&M phases). <p>Tier 4</p> <p>No projects identified.</p>	screened in as they could pose a risk of injury and disturbance generated by Wind Turbine operation for marine mammal receptors and therefore require consideration at a cumulative scale with the Proposed Development.
Injury to marine mammals due to collision with vessels	✓	✓	✓	<p>The MDS is as detailed for the Proposed Development alone in Table 10.19, cumulatively with the following projects:</p> <p>Tier 1</p> <p>No projects identified.</p> <p>Tier 2</p> <p><u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> Ossian OWF (all phases); and Berwick Bank OWF (all phases). <p><u>Offshore Export Cable Routes and Carbon Capture Storage</u></p> <ul style="list-style-type: none"> Seagreen Phase 1A OFTO (O&M and decommissioning phases); Inch Cape OFTO (O&M and decommissioning phases); and Berwick Bank OFTO (O&M and decommissioning phases). <p><u>Cables within 50 km of the Proposed Development</u></p> <ul style="list-style-type: none"> Eastern Green Link 2 (O&M and decommissioning phases). 	As detailed in Paragraph 10.12.8, a precautionary buffer of 50 km from the Array Area and/or Export Cable Corridor was used to screen in projects from the CEA long list into the CEA for this impact.

Potential Cumulative Effect	Phase*			MDS	Justification
	C	O&M	D		
				<p>Tier 3 <u>Offshore Wind Projects and Associated Cables</u></p> <ul style="list-style-type: none"> • Morven North OWF Array(all phases); and • Morven South OWF Array (all phases). <p><u>Offshore Export Cable Routes and Carbon Capture Storage</u></p> <ul style="list-style-type: none"> • Morven Hawthorn Pit Grid Connection Project (construction and O&M phases); and • Ossian Transmission Infrastructure (construction and O&M phases). <p><u>Pipelines within 100 km of the Proposed Development</u></p> <ul style="list-style-type: none"> • CNSE Project (O&M phases only). <p>Tier 4 No projects identified.</p>	
Effects on marine mammals due to altered prey availability	✓	✓	✓	The MDS is as described in Volume 2, Chapter 9: Fish and Shellfish Ecology. Potential cumulative impacts on fish and shellfish include temporary and long-term habitat loss and disturbance, introduction of artificial hard structures and subsequent colonisation, increased SSCs and associated deposition, subsea noise, and EMF.	As detailed in Paragraph 10.12.8, the projects considered in Volume 2, Chapter 9: Fish and Shellfish Ecology are considered in the assessment of this potential impact.

* Project Phase refers to construction (C), O&M (O) and decommissioning (D).

Cumulative Effects Assessment

10.12.10 An assessment of the likely significance of the cumulative effects of the Proposed Development upon marine mammal receptors arising from each identified impact is given below.

INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING PILING

Tier 2

Construction Phase

10.12.11 As detailed in Table 10.66, there were 11 Tier 2 projects identified with the potential for cumulative impacts associated with subsea noise generated during piling.

- Ossian OWF (in its construction phase);
- Berwick Bank OWF (in its construction phase);
- Muir Mhòr OWF (in its construction phase);
- Aspen OWF (in its construction phase);
- MarramWind OWF (in its construction phase);
- Caledonia OWF South (in its construction phase);
- Caledonia OWF North (in its construction phase);
- Cenos OWF (in its construction phase);
- Ayre OWF (in its construction phase);
- Dogger Bank South West (in its construction phase); and
- Dogger Bank South East (in its construction phase).

10.12.12 The Wind Turbine and OSP piling parameters (where relevant) for the Tier 2 projects, alongside those of the Proposed Development, are presented in Table 10.66 and Table 10.67. The construction phases of each Tier 2 project are also included in these tables; however, it should be noted that piling at each of these projects will occur as a discrete stage within the overall construction phase and therefore the periods of piling may not coincide. These timelines are therefore indicative and may be subject to change.

Table 10.67: Wind Turbine Piling Parameters Incorporated into the MDSs of the Tier 2 Projects

Project	Max Capacity Project (MW)	Maximum Number of Wind Turbines	Maximum Number of Piles	Maximum Pile Diameter (m)	Maximum Hammer Energy (kJ)	Maximum Number of Piling Days	Construction Phase	Reference
Proposed Development	1,000	67	268	3.8	4,500	268	2031 – 2034, with piling occurring in 2031 to 2033	Table 10.19
Ossian OWF	3,600	265	1,590	4.5	3,000	530	2031 – 2038	Ossian OWF Limited (2024)
Berwick Bank OWF	4,100	307	1,432	5.5	4,000	95	2027 – 2032 with piling occurring in 2031	SSE Renewables (2022)
Muir Mhòr OWF	798	67	603	4	2,400	151	2027 – 2030 with piling between this time	Muir Mhòr Offshore Wind Farm (2024)
Aspen OWF	1,008	72	324	4.5	2,400	112	2027 – 2031 with piling occurring between this time.	Cerulean Winds Aspen Project Limited (2025)
MarramWind OWF	3,000	225	1,800	3	3,500	1,800	2030 – 2040 with piling occurring between this time	MarramWind Limited (2025)
Caledonia OWF South	2,000	101	404	4	4,400	105	2028 – 2030	Caledonia OWF Limited (2024)
Caledonia OWF North	2,000	101	404	4	4,400	105	2028 – 2030	Caledonia OWF Limited (2024)
Cenos OWF	1,400	95	855	4.5	2,500	285	2030 – 2034 with piling occurring between 2031 and 2033	Cenos Offshore Windfarm Limited (2024)
Ayre OWF		40	360	5	4,500	Information not provided	2030 – 2034 with piling occurring between this time	Ayre Offshore Wind Farm Limited (2025)

Project	Max Capacity Project (MW)	Maximum Number of Wind Turbines	Maximum Number of Piles	Maximum Pile Diameter (m)	Maximum Hammer Energy (kJ)	Maximum Number of Piling Days	Construction Phase	Reference
Dogger Bank South West	1,500	100	400	4	3,000	Information not provided	2026 – 2030 with piling occurring between 2027 and 2029	RWE Renewables Dogger Bank South OWF Limited (2025)
Dogger Bank South East	1,500	100	400	4	3,000	Information not provided	2026 – 2030 with piling occurring between 2027 and 2029	RWE Renewables Dogger Bank South OWF Limited (2025)

Table 10.68: OSP Piling Parameters Incorporated into the MDSs of the Tier 2 Projects

Project	Maximum Number of OSPs*	Maximum Number of Piles	Maximum Pile Diameter (m)	Maximum Hammer Energy (kJ)	Maximum Number of Piling Days	Construction Phase	Reference
Proposed Development	2	36	4.5	4,500	22	2031 – 2034, with piling occurring between 2031 and 2034	Section 10.10
Ossian OWF	15	216	4.5	4,400	72	2031 – 2038 with piling occurring between 2031 and 2038	Ossian OWFL (2024)
Berwick Bank OWF	8	192	3	4,000	17	2027 – 2032 with piling occurring in 2031	SSE Renewables (2022)
Muir Mhòr OWF	2	12	5	3,200	24	2027 – 2030 with piling occurring between this time	Muir Mhòr Offshore Wind Farm (2024)

Project	Maximum Number of OSPs*	Maximum Number of Piles	Maximum Pile Diameter (m)	Maximum Hammer Energy (kJ)	Maximum Number of Piling Days	Construction Phase	Reference
Aspen OWF	3	24	3	3,500	12	2027 – 2031 with piling occurring between this time.	Cerulean Winds Aspen Project Limited (2025)
MarramWind OWF	4	48	3	3,500	48	2030 – 2040	MarramWind Limited (2025)
Caledonia OWF South	2	Information not provided	4.8	2,000	410	2028 – 2030	Caledonia OWF Limited (2024)
Caledonia OWF North	2	Information not provided	4.8	2,000	410	2028 – 2030	Caledonia OWF Limited (2024)
Cenos OWF	2	12	3.5	4,400	8	2030 – 2034 with piling occurring between 2031 and 2033	Cenos Offshore Windfarm Limited (2024)
Ayre OWF	2	36	4.5	4,500	Information not provided	2030-2034	Ayre Offshore Wind Farm Limited (2025)
Dogger Bank South West*	2	N/A	15	6,000	Information not provided	2026 – 2030 with piling occurring between 2027 and 2029	RWE Renewables Dogger Bank South OWF Limited (2025)
Dogger Bank South East*	2	N/A	15	6,000	Information not provided	2026 – 2030 with piling occurring between 2027 and 2029	RWE Renewables Dogger Bank South OWF Limited (2025)

* For Dogger Bank South West and Dogger Bank South East the structures for the project developments were referred not as Offshore Substation Platforms but Offshore Converter Platforms (OCP)/Collector Platforms (CP) (RWE Renewables Dogger Bank South OWF Limited, 2025)

Magnitude of Impact

- 10.12.13 The maximum number of animals potentially disturbed, and the associated percentage of the UK portion of the species' MU and total MU population are presented Table 10.69 to Table 10.74. These maximum numbers have been derived from a range of different piling scenarios, with the parameters detailed in Table 10.66 and Table 10.67 above.
- 10.12.14 Methods used to assess behavioural disturbance differed across the Tier 2 projects, with criteria and noise thresholds used in the modelling differing between projects. Therefore, it is necessary to exercise considerable caution when comparing the noise modelling results of each Tier 2 project, which are presented in Table 10.66 and Table 10.67. There were also differences between projects in the way results were presented, and in which species were assessed. For the assessment of the Proposed Development alone, Risso's dolphin, fin whale and humpback whale were assessed qualitatively. Similarly, these species were either not assessed for the Tier 2 projects or also assessed qualitatively. These species are therefore not discussed in further detail. In addition, not all the Tier 2 projects assessed the same species.
- 10.12.15 Some projects presented the disturbance range within which animals could experience behavioural disturbance, and the potential numbers of animals disturbed, whilst others only presented the number of animals disturbed. In addition, varied densities were used across the Tier 2 projects to estimate the number of animals potentially disturbed. As these values were derived from different sources, density details may reflect various densities of respective species throughout the year (i.e. seasonal versus average across the year). The Tier 2 projects also used different reference populations and MU. Therefore, assessment of the potential behavioural effects on marine mammals predicted by the Tier 2 projects is not directly comparable to those presented for the Proposed Development alone due to different approaches taken by other offshore developers, with different noise criteria and thresholds used, and differing levels of detail presented in associated EIAs.
- 10.12.16 Given uncertainty in the degree of temporal and spatial overlap of these activities summing these figures would give an overestimate of the total number of animals impacted. There is also the possibility that the same individuals might be affected on multiple occasions across projects sequentially. Given uncertainties surrounding animal turnover and movements at this temporal and spatial scale it is very challenging to predict a realistic overall level of disturbance. Sinclair (2025) provides a robust discussion on the challenges for offshore wind cumulative assessment for marine mammals. Key challenges are a lack of standardisation of the screening range, the timeframe for consideration, and the approach to the quantitative assessment. It is highlighted in this paper that CEAs assume compounding MDSs.

10.12.17 In the absence of a guidance for a standardised approach, this assessment has followed the common industry approach taken for marine mammal CEA. The disturbance impacts predicted for the Proposed Development together with the Tier 2 projects identified have been taken through for population modelling using iPCoD in order to inform the CEA. At the time of the iPCoD modelling the relevant quantitative information required for the models for MarramWind OWF and Ayre OWF was not available and any estimate would be unlikely to reflect the realised piling programmes. Therefore, the iPCoD modelling and assessment presents results for the remaining projects stated above (Paragraph 10.12.11). The maximum temporal situation was used as a maximum design scenario.

Harbour Porpoise

Magnitude of Impact

10.12.18 Table 10.69 presents compiled information on the predicted effects from Tier 2 projects included in the iPCoD cumulative assessment for harbour porpoise (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report).

Table 10.69: Harbour Porpoise Number of Animals Disturbed for the CEA as a Result of Subsea Noise Generated During Piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	12,776	8.00%	3.69%	Low
		OSP	12,776	8.00%	3.69%	
	Maximum temporal scenario	Piling	3,651	2.29%	1.05%	
		OSP	3,651	2.29%	1.05%	
Ossian OWF (Ossian OWFL, 2024)	Maximum spatial scenario	Piling & OSP	8,309	Not provided	2.4%	Negligible
	Maximum temporal scenario	Piling	3,857		1.11%	
		OSP	7,310		2.11%	
	Maximum spatial scenario	Piling	2,822		7.3% of SCANS III Block R (not UK portion of MU)	
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	OSP	1,754	4.54% of SCANS III Block R (not UK portion of MU)	0.51%	
		Maximum temporal scenario	Piling	2,815	7.13% of SCANS III Block R (not UK portion of MU)	0.80%
	Maximum temporal scenario	OSP	1,828	4.63% of SCANS III Block R (not UK portion of MU)	0.53%	
		Maximum spatial scenario	Piling & OSP	15,579	9.47%	4.49%
Maximum temporal scenario	Piling	14,630	8.88%	4.22%		
	OSP	15,245	9.29%	4.40%		
Aspen OWF (Cerulean)		Piling (single anchor)	10,652	6.41%	3.07%	Low

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Winds Aspen Project Limited, 2025)	Maximum spatial scenario	OSP (jack pile driving)	10,603	6.33%	3.06%	
MarramWind OWF*	Maximum design scenario	Piling (floating)	14,787	9.01%	4.27%	Low
Caledonia OWF South (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (jacket)	8,132	5.06%	2.35%	Low
		Piling (monopile)	8,881	5.51%	2.56%	
	Maximum temporal scenario	Piling (jacket)	8,201	5.08%	2.37%	
		Piling (anchor)	6,648	1.92%	4.14%	
Caledonia OWF North (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	7,823	4.87%	2.26%	Low
	Maximum temporal scenario	Piling (jacket)	7,274	4.52%	2.10%	
Cenos OWF (Cenos Offshore Windfarm Limited, 2024)	Maximum spatial scenario	Not provided				Low
	Maximum temporal scenario	Piling	8,863	5.55%	Not provided	
		OSP	9,529	5.97%	Not provided	
Ayre OWF*	Maximum spatial scenario	Piling & OSP (floating)	5,334	3.34%	1.54%	Low

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
	Maximum temporal scenario	Piling & OSP (two floating foundations)	8,101	5.01%	2.34%	
Dogger Bank South West (RWE Renewables Dogger Bank South OWF Limited, 2025)	Maximum spatial scenario	Piling (monopile)	1,401.6	Not provided	0.40%	Negligible
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West and Dogger Bank South East)	2,675.9	Not provided	0.77%	
Dogger Bank South East (RWE Renewables Dogger Bank South OWF Limited, 2025)	Maximum spatial scenario	Piling (monopile)	1,274.2	Not provided	0.37%	Negligible
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West and Dogger Bank South East)	2,675.9	Not provided	0.77%	

* As mentioned within Paragraph 10.12.17 these projects were not included within the iPCoD modelling for marine mammals.

- 10.12.19 Results of the cumulative iPCoD modelling for harbour porpoise (Figure 10.27) demonstrate there is a potential population-level effect between the impacted and un-impacted scenarios. Given that the differences in impacted to un-impacted populations approaches a ratio of 0.91 at time points 16 and 26 (10 and 20 years post piling at Proposed Development) there is considered to be potential for a long-term population-level effect from this cumulative piling scenario upon harbour porpoise within the North Sea MU. However, given the anticipated high level of activity within the Regional Marine Mammal Study Area, it is important to contextualise the relative contribution of the Proposed Development to the overall cumulative effect. While cumulative pressures demonstrate there is a potential population-level effect at the regional scale, modelling undertaken for the Proposed Development alone did not predict any population-level impacts on marine mammals (see Section 10.10). This distinction is important in understanding the specific role of the Proposed Development within the wider cumulative impact assessment.
- 10.12.20 As such, a separate scenario was modelled for the Tier 2 projects without the inclusion of Proposed Development (Figure 10.28). Here, a similar population trajectory was observed, with a short-term decrease in animals followed by a steady recovering an increasing population (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report for more detail). These results indicate that the potential cumulative impact arises from the simultaneous aggregation of multiple projects rather than from any single project in isolation.

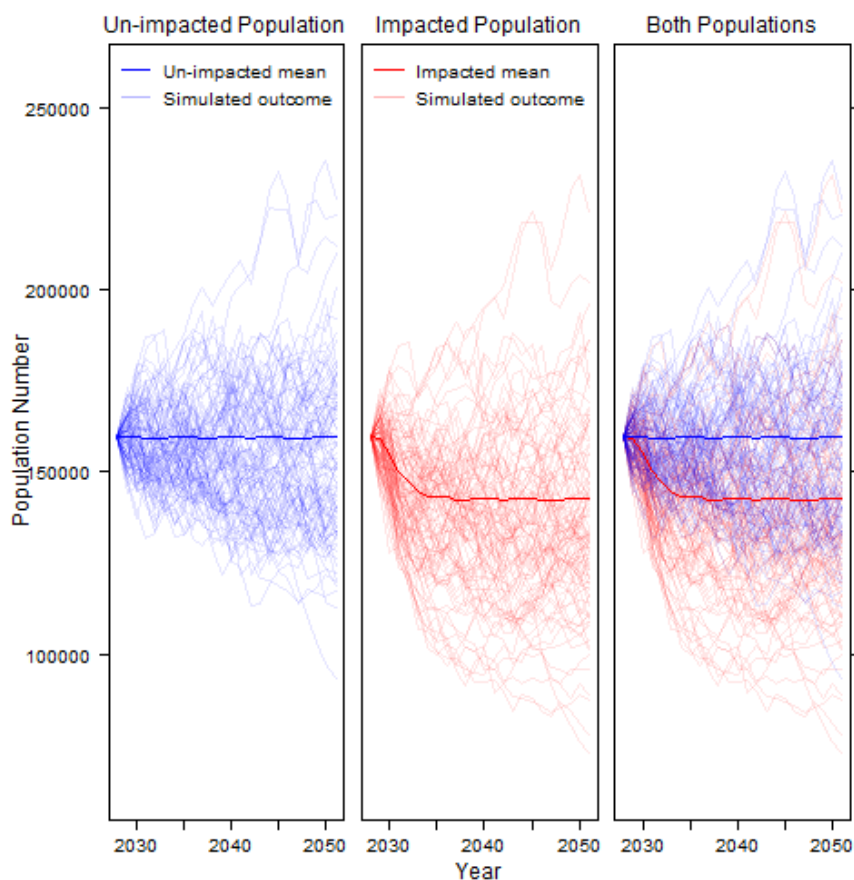


Figure 10.27: Simulated Harbour Porpoise Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario

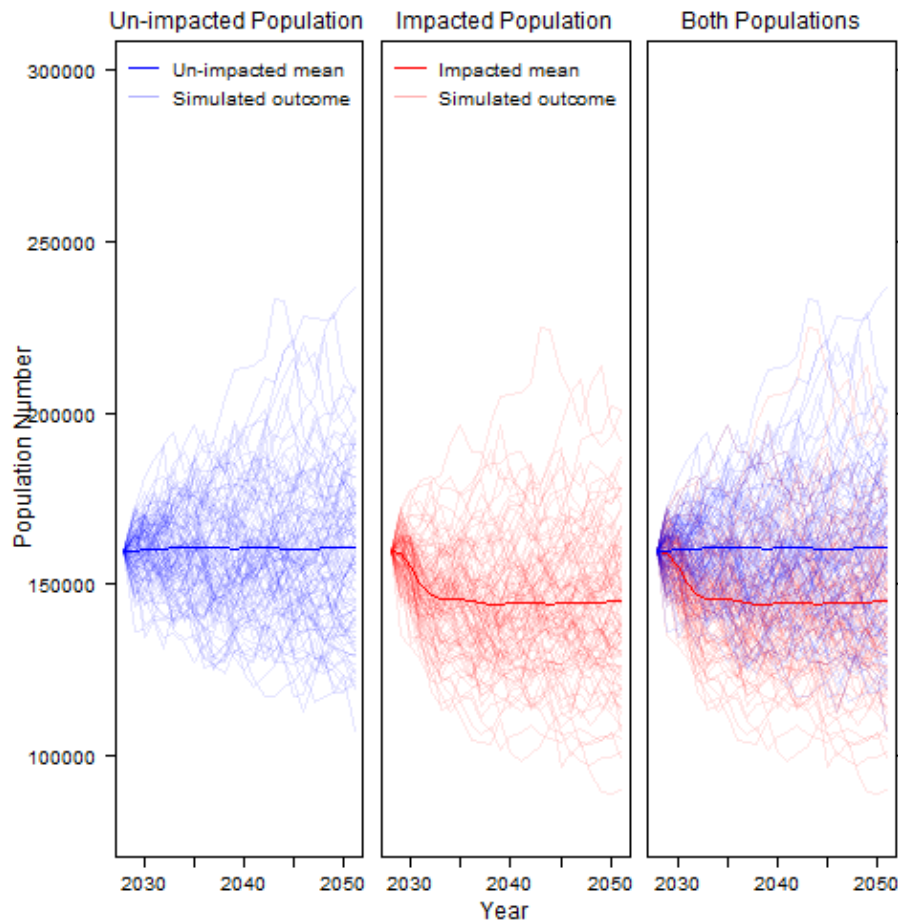


Figure 10.28: Simulated Harbour Porpoise Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario Excluding Bowdun OWF

10.12.21 The extent of the impact is anticipated to be over a large scale or geographic extent (in terms of proportion of the reference population). The effect is anticipated to occur over a medium-term duration. The impact is anticipated to occur intermittently throughout the cumulative piling period. The population modelling predicts a population impact from the assessed cumulative impact piling. The impact could result in some measurable changes to individuals that are disturbed (i.e. interruption of feeding or breeding and/or displacement to alternative areas), that could lead to population-level consequences of disturbance. The magnitude for harbour porpoise is therefore high.

Sensitivity of Receptor

10.12.22 The sensitivity of the receptor is as defined in Paragraphs 10.10.93 *et seq.* above for the Project alone assessment.

10.12.23 Harbour porpoise is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the harbour porpoise is conservatively considered to be medium.

Significance of Effect

- 10.12.24 Overall, the magnitude of the cumulative impact is deemed to be high, and the sensitivity of the receptor is considered to be medium. Although, the significance conclusion is Moderate to Major, due to the level of over-precaution in the assessment of disturbance impacts, the effect is concluded to be of **Moderate** adverse significance, which is significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.25 The modelling conducted has shown that the potential population decline due to the combined CEA projects is not driven by the Proposed Development. As previously discussed in Paragraph 10.12.18, cumulative iPCoD modelling results for harbour porpoise demonstrated a potential long-term population-level effect under the aggregated piling scenario. However, when the Proposed Development was excluded from the Tier 2 scenario, a similar population trajectory was observed, indicating that the cumulative impact arises from the aggregation of multiple projects rather than from any single development.
- 10.12.26 This comparative modelling highlights the relatively minor contribution of the Proposed Development to the overall cumulative effect. The population-level changes observed are consistent across scenarios with and without the Proposed Development, reinforcing the conclusion that the Proposed Development is not a key driver of the cumulative impact. Therefore, no Additional Mitigation is considered necessary.

Bottlenose Dolphin

Magnitude of Impact

- 10.12.27 Table 10.70 presents compiled information on the predicted effects from Tier 2 projects included in the cumulative iPCoD assessment for bottlenose dolphin (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report).

Table 10.70: Bottlenose Dolphin Number of Animals Disturbed for the CEA as a Result of Subsea Noise Generated During Piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	141	6.68%	6.27%	Low
		OSP	141			
	Maximum temporal scenario	Piling	41	1.91%	1.79%	
		OSP	41			
Ossian OWF (Ossian OWFL, 2024)	Maximum spatial scenario	Piling (anchor)	5	Not provided	2.23%	Low
	Maximum temporal scenario	Piling	2	Not provided	0.89%	
		OSP	4		1.79%	
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	Piling	5	2.25%	Not provided	Low
	Maximum temporal scenario	Piling	5	2.25 %	Not provided	
		OSP	4	1.49%		
Muir Mhòr OWF (Muir Mhòr Offshore Wind Farm, 2024)	Maximum spatial scenario	Piling & OSP	Coastal East Scotland: 8 GNS: 78	Coastal East Scotland: 3.23% GNS: 3.86%	Not provided	Low
	Maximum temporal scenario	Piling	82	Not provided		
		OSP	82			
Aspen OWF (Cerulean Winds Aspen Project Limited, 2025)	Maximum spatial scenario	Piling (single anchor)	18	0.89%	0.86%	Low
		OSP (jack pile driving)	18	0.88%	0.85%	

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
MarramWind OWF*	Maximum design scenario	Piling (floating)	586	30.24%	28.98%	Medium
Caledonia OWF South (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling	57	Not provided	23.27%	Low
	Maximum temporal scenario	Piling (jacket)	52	Not provided	21.22%	
		Piling (anchor)	46	Not provided	18.78%	
Caledonia OWF North (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	52	Not provided	21.22%	Low
	Maximum temporal scenario	Piling (jacket)	48	Not provided	19.59%	
Cenos OWF (Cenos Offshore Windfarm Limited, 2024)	Maximum spatial scenario	Piling	254	13.47%	Not provided	High
		OSP	273	14.48%	Not provided	
Ayre OWF*	Maximum spatial scenario	Piling & OSP (floating)	42	1.96%	1.84%	Low
	Maximum temporal scenario	Piling & OSP (two floating foundations)	63	2.98%	2.80%	

* As mentioned within Paragraph 10.12.17 these projects were not included within the iPCoD modelling for marine mammals.

- 10.12.28 The Tier 2 projects Dogger Bank South East and Dogger Bank South West were not included within Table 10.70 as the EIA for the Dogger Bank South projects did not quantitatively assess bottlenose dolphin for the disturbance of marine mammals from piling.
- 10.12.29 This was due to the lack of information on potential disturbance ranges and so no estimated number of animals disturbed were calculated (RWE Renewables Dogger Bank South OWF Limited, 2025). It was therefore not possible to include both Dogger Bank South projects within this quantitative cumulative assessment for bottlenose dolphins.
- 10.12.30 As for the assessment of the project alone iPCoD modelling for bottlenose dolphin for the cumulative assessment included the modelling using the Coastal East Scotland MU vital rates and GNS MU vital rates (see Paragraph 10.10.64).
- 10.12.31 Results of the cumulative iPCoD modelling for bottlenose dolphin using the Coastal East Scotland MU vital rates indicate that there may be a short-term impact between the impacted and un-impacted simulated population trajectories (Figure 10.29) but not at a level that is expected to cause long-term population-level effects. The difference after 20 years between impacted and un-impacted populations is 259 animals (which equates to 12.27% of the UK portion of the combined MU reference population and 11.52% of the full combined MUs). However, because the median counterfactual of population size at time-point 26 was 0.998 (while the mean counterfactual was 0.950 (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report) and therefore close to one a long-term population impact is not anticipated.

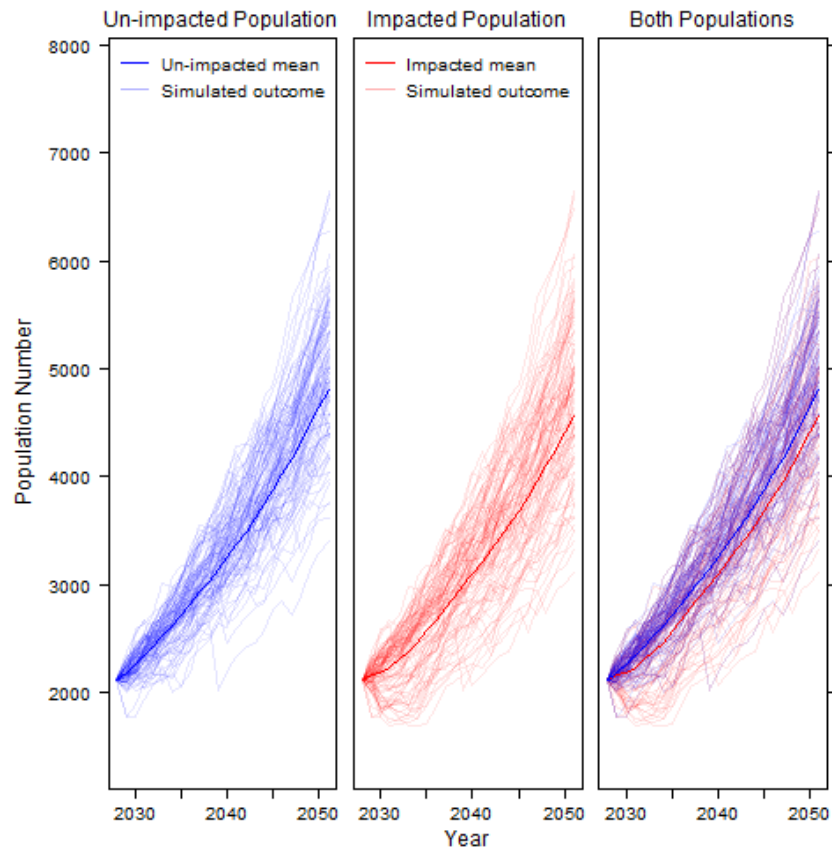


Figure 10.29: Simulated Bottlenose Dolphin Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario (Coastal East Scotland MU Vital Rates)

10.12.32 Results of the cumulative iPCoD modelling for bottlenose dolphin using the GNS MU vital rates indicate that there may be a short-term impact between the impacted and un-impacted simulated population trajectories (Figure 10.30) but not at a level that is expected to cause long-term population-level effects. The difference after 20 years between impacted and un-impacted populations is 74 animals (which equates to 3.51% of the UK portion of the MU reference population and 3.29% of the full MU). The median counterfactual of population size at time-point 26 was 0.999 (while the mean counterfactual was 0.960 (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report) and therefore close to one a long-term population impact is not anticipated.

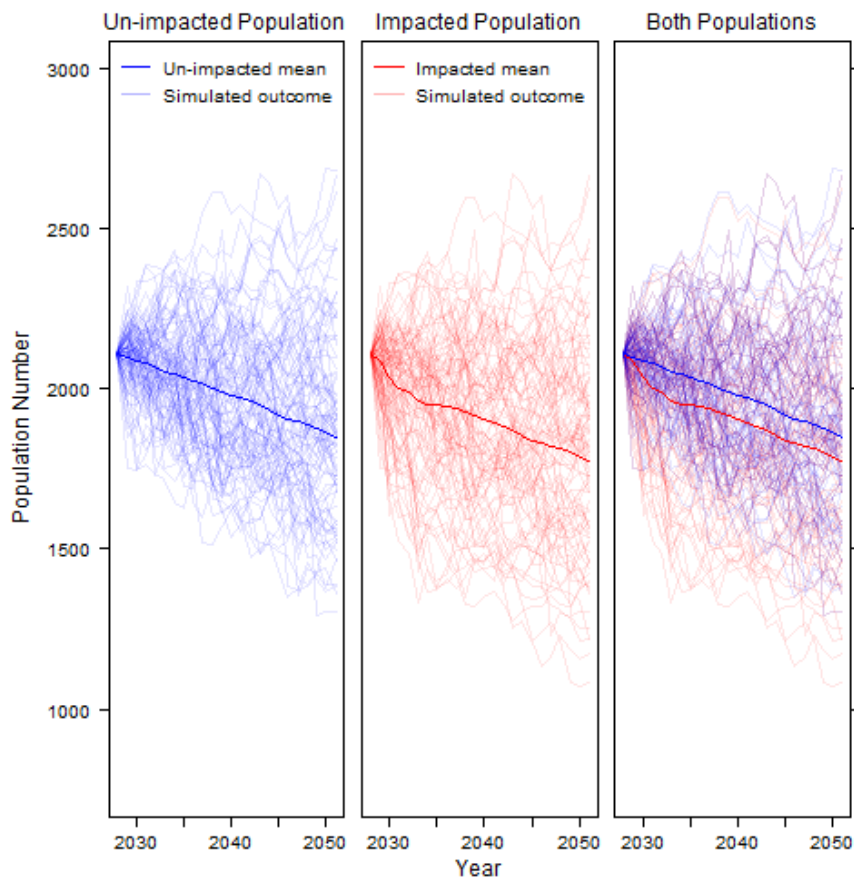


Figure 10.30: Simulated Bottlenose Dolphin Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario (GNS MU Vital Rates)

10.12.33 The cumulative impact (due to elevated subsea noise arising during piling) is predicted to be of regional spatial extent, medium-term duration, intermittent and high reversibility (with animals returning to baseline levels within hours/days after piling have ceased). Impacts could result in temporary changes to behavioural and/or distribution of individuals, but not at a scale that could result in adverse effects to the population trajectory. The magnitude is therefore considered to be medium.

Sensitivity of Receptor

10.12.34 The sensitivity of the receptor is as defined in Paragraphs 10.10.98 *et seq.* above for the Project alone assessment.

10.12.35 The bottlenose dolphin is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the bottlenose dolphin is conservatively considered to be low.

Significance of Effect

10.12.36 Overall, the magnitude of the cumulative impact is deemed to be medium and the sensitivity of the receptor is considered to be low. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.37 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not considered to be significant in EIA terms.

White-beaked Dolphin

Magnitude of Impact

- 10.12.38 Table 10.71 presents compiled information on the predicted effects from Tier 2 projects included in the cumulative assessment for white-beaked dolphin.

Table 10.71: White-beaked Dolphin Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	1,273	3.74%	2.90%	Low
		OSP	1,273			
	Maximum temporal scenario	Piling	892	2.62%	2.03%	
		OSP	892			
Ossian OWF (Ossian OWFL, 2024)	Maximum spatial scenario	Piling	1,531	Not provided	3.48%	Negligible
	Maximum temporal scenario	Piling	710		1.62%	
		OSP	1,347		3.07%	
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	Piling	830	Not provided	1.89	Low
	Maximum temporal scenario	Piling/OSP	516	Not provided	1.17	
Muir Mhòr OWF (Muir Mhòr Offshore Wind Farm, 2024)	Maximum spatial scenario	Piling & OSP	6,984	20.49%	15.89%	Medium
Aspen OWF (Cerulean Winds Aspen Project Limited, 2025)	Maximum spatial scenario	Piling (single anchor)	3,644	10.29%	8.29%	Medium
		OSP (jack pile driving)	3,627	10.15%	8.25%	
MarramWind OWF	Maximum design scenario	Piling (floating)	8,181	23.37%	18.61%	Medium

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Caledonia OWF South (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	3,113	9.02%	7.08%	Medium
	Maximum temporal scenario	Piling (jacket)	2,873	8.31%	6.54%	
		Piling (anchor)	2,363	6.88%	5.38%	
Caledonia OWF North (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	2,857	8.32%	6.50%	Medium
	Maximum temporal scenario	Piling (jacket)	2,624	7.62%	5.97%	
Cenos OWF (Cenos Offshore Windfarm Limited, 2024)	Maximum spatial scenario	Piling	896	Not provided	2.63%	Medium
		OSP	964		2.38%	
	Maximum temporal scenario	OSP	10	Not provided	0.021%	
Ayre OWF	Maximum spatial scenario	Piling & OSP (floating)	4,579	51.12%	14.30%	Medium
	Maximum temporal scenario	Piling & OSP (two floating foundations)	6,955	77.64%	21.72%	

- 10.12.39 The Tier 2 projects Dogger Bank South East and Dogger Bank South West were not included within Table 10.70 as the EIA for the Dogger Bank South projects did not quantitatively assess white-beaked dolphin for the disturbance of marine mammals from piling.
- 10.12.40 This was due to the lack of information on potential disturbance ranges and so no estimated number of animals disturbed were calculated (RWE Renewables Dogger Bank South OWF Limited, 2025). It was therefore not possible to include both Dogger Bank South projects within this quantitative cumulative assessment for white-beaked dolphins.
- 10.12.41 The current version of iPCoD does not allow modelling for this species and therefore population modelling has not been carried out for this species.
- 10.12.42 Whilst it is inappropriate to combine the total number of white-beaked dolphin predicted to be at risk of disturbance, the numbers are an indication that potentially a large proportion of the management unit reference population could be cumulatively at risk of disturbance. With over 10% of the MU predicted potentially affected from the Proposed Development and Muir Mhòr OWF.
- 10.12.43 The cumulative impact (due to elevated subsea noise arising during piling) is predicted to be of regional spatial extent, medium-term duration, intermittent and high reversibility (with animals returning to baseline levels within hours/days after piling have ceased). Impacts could result in temporary changes to behavioural and/or distribution of individuals, but not at a scale that could result in adverse effects to the population trajectory. The magnitude is therefore considered to be medium.

Sensitivity of Receptor

- 10.12.44 The sensitivity of the receptor is as defined in Paragraphs 10.10.98 *et seq.* above for the Project alone assessment.
- 10.12.45 The white-beaked dolphin is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the white-beaked dolphin is conservatively considered to be low.

Significance of Effect

- 10.12.46 Overall, the magnitude of the cumulative impact is deemed to be medium and the sensitivity of the receptor is considered to be low. The effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.47 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not considered to be significant in EIA terms.

Minke Whale

Magnitude of Impact

- 10.12.48 Table 10.72 presents compiled information on the predicted effects from Tier 2 projects included in the cumulative assessment for minke whale.

Table 10.72: Minke Whale Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	604	5.87%	3.00%	Low
		OSP	604	5.87%		
	Maximum temporal scenario	Piling	173	1.68%	0.86%	
		OSP	173			
Ossian OWF (Ossian OWFL, 2024)	Maximum spatial scenario	Piling & OSP	362	Not provided	1.8%	Low
	Maximum temporal scenario	Piling	169	Not provided		
		OSP	319			
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	Piling	132	0.66%		Low
	Maximum temporal scenario	Piling	132	0.66%		
		OSP	86	0.41%		
Muir Mhòr OWF (Muir Mhòr Offshore Wind Farm, 2024)	Maximum spatial scenario	Piling & OSP	792	7.51%	3.94%	Low
	Maximum temporal scenario	Piling	735	Not provided	3.65%	
Aspen OWF (Cerulean Winds Aspen Project Limited, 2025)	Maximum spatial scenario	Piling (single anchor)	1,368	12.78%	6.80%	Low
		OSP (jack pile driving)	1,362	12.61%	6.77%	
MarramWind OWF*	Maximum design scenario	Piling (floating)	935	8.85%	4.65%	Low
	Maximum spatial scenario	Piling	556	5.36%	2.76%	Low

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Caledonia OWF South (Caledonia OWF Limited, 2024)	Maximum temporal scenario	Piling (jacket)	502	4.82%	2.50%	
		Piling (anchor)	415	4.01%	2.06%	
Caledonia OWF North (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	508	4.91%	2.53%	Low
	Maximum temporal scenario	Piling (jacket)	458	4.79%	2.48%	
Cenos OWF (Cenos Offshore Windfarm Limited, 2024)	Maximum temporal scenario	Piling	358	Not provided	3.47%	Low
		OSP	384		3.73%	
Ayre OWF*	Maximum spatial scenario	Piling & OSP (floating)	166	1.61%	0.82%	Low
	Maximum temporal scenario	Piling & OSP (two floating foundations)	252	2.44%	1.25%	
Dogger Bank South West (Dogger Bank South Offshore Wind Farms, 2025)	Maximum spatial scenario	(monopile)	56.5	Not provided	0.28%	Negligible
	Maximum temporal scenario	Piling (jacket pin piles at Dogger Bank South West, Dogger Bank South East and offshore export cable corridor)	141.4	Not provided	0.70%	
Dogger Bank South East (Dogger Bank	Maximum spatial scenario	(monopile)	28.3	Not provided	0.14%	Negligible

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
South Offshore Wind Farms, 2025)	Maximum temporal scenario	Piling (monopile at Dogger Bank South West, Dogger Bank South East and offshore export cable corridor)	141.4	Not provided	0.70%	

* As mentioned within Paragraph 10.12.17 these projects were not included within the iPCoD modelling for marine mammals.

10.12.49 Results of the cumulative iPCoD modelling for minke whale demonstrate whilst there is potential for a small short-term impact between the impacted and un-impacted scenarios (Figure 10.31, see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report), the modelled populations show recovery from 2035 and a stable trajectory. Volume 3, Technical Appendix 10.3 Marine Mammal iPCoD Modelling Report highlighted that the cumulative effects for minke whale is driven by the impact piling during the three years prior to the Proposed Development’s piling activity (Aspen, Caledonia, Dogger Bank South West and Muir Mhòr). At time-point 26 (2053) which is 20 years after the end of piling at the Proposed Development, the difference between impacted and un-impacted populations is 56 animals (which equates to 0.54% of the UK portion of the MU reference population/0.28% of the full MU). The median counterfactual of population size at time-point 26 was one, while the mean counterfactual was 0.994 (see Volume 3, Technical Appendix 10.3 Marine Mammal iPCoD Modelling Report for more detail).

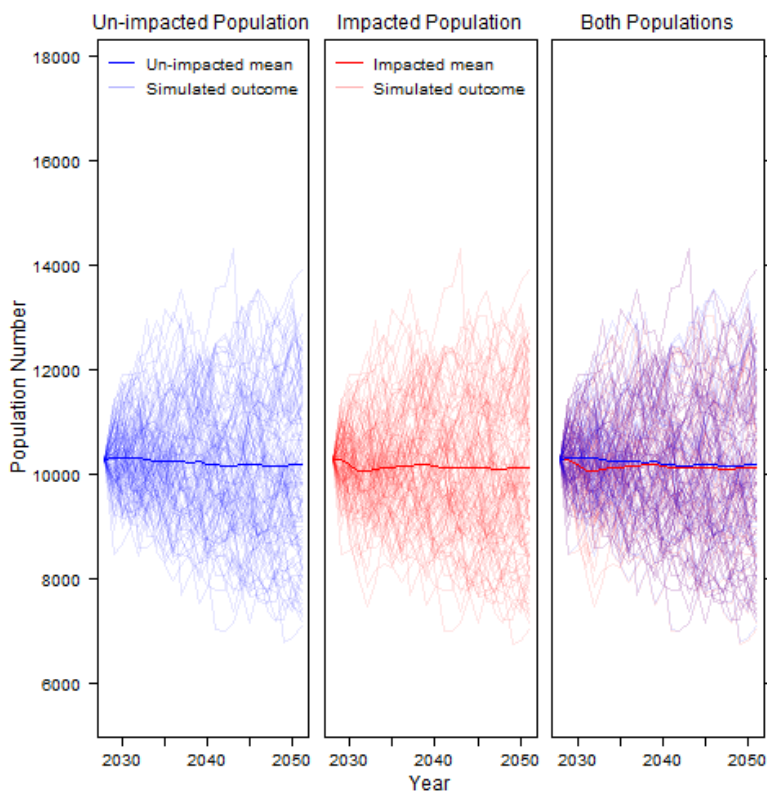


Figure 10.31: Simulated Minke Whale Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario

10.12.50 Given that the differences in impacted to un-impacted populations is a median ratio of one throughout, there is considered to be no potential for a long-term population-level effect from this cumulative piling scenario upon minke whale within the MU.

10.12.51 The cumulative impact (due to elevated subsea noise arising during piling) is predicted to be of limited scale in the context of the proportion of the reference population. Short-term or temporary effects in a small proportion of the reference population. Whilst there may be effects at an individual level, these would not be at a scale that would lead to any measurable population-level

effects above natural variation. The magnitude is therefore considered to be low.

Sensitivity of Receptor

10.12.52 The sensitivity of the receptor is as defined in Paragraphs 10.10.103 *et seq.* above for the Project alone assessment.

10.12.53 The minke whale is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the minke whale is conservatively considered to be low.

Significance of Effect

10.12.54 Overall, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be low. Although, the significance conclusion is Negligible or Minor, due to the level of over-precaution in the assessment of impacts due to disturbance, the effect is concluded to be of **Negligible** adverse significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.12.55 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not considered to be significant in EIA terms.

Grey Seal

Magnitude of Impact

10.12.56 Table 10.73 presents compiled information on the predicted effects from Tier 2 included in the cumulative assessment for grey seal.

Table 10.73: Grey Seal Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA		
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	1,772	North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU: 3.32%		Medium		
		OSP						
	Maximum temporal scenario	Piling	904	North Coast and Orkney SMU, the Moray Firth SMU and the East Scotland SMU: 1.69%				
		OSP						
Ossian OWF (Ossian OWFL, 2024)	Maximum spatial scenario	Piling & OSP	436	1.19%	Not provided	Negligible		
	Maximum temporal scenario	Piling	131	0.36%	Not provided			
		OSP	344	0.94%				
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	Piling/OSP	1,358	3.19%	Not provided	Low		
	Maximum temporal scenario	Piling	1450	Not provided				
		OSP	720					
Muir Mhòr OWF (Muir Mhòr Offshore Wind Farm, 2024)	Maximum spatial scenario	Piling & OSP	1,225	11.36%	Not provided	Low		
	Maximum temporal scenario	Piling	1,156	10.72%				
		OSP	1,176				10.91%	
Aspen OWF (Cerulean Winds Aspen Project Limited, 2025)	Maximum spatial scenario	Piling (single anchor)	107	1.7%		Low		
		OSP (jack pile driving)	114	1.81%				
MarramWind OWF*	Maximum design scenario	Piling (floating)	455 (East Scotland SMU specific)	East Scotland SMU: 7.23%		Low		

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA	
Cenos OWF (Cenos Offshore Windfarm Limited, 2024)	Maximum temporal scenario	Piling	127	4.66%		Negligible	
		OSP	137	5.02%			
	Maximum temporal scenario	Piling	131	0.36%	Not provided		
		OSP	344	0.94%			
Ayre OWF*	Maximum spatial scenario	Piling & OSP (floating)	1,864	North Coast and Orkney and Moray Firth SMU: 4.48%		Medium	
	Maximum temporal scenario	Piling & OSP (two floating foundations)	2,293	North Coast and Orkney and Moray Firth SMU: 5.52%			
Dogger Bank South West (Dogger Bank South Offshore Wind Farms, 2025)	Maximum spatial scenario	Piling (monopile)	510.5	Not provided	Wider MU: 0.90% South East England MU: 1.67%	Low	
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West, Dogger Bank South East and offshore export cable corridor)	1,376.4	Not provided	Wider MU: 2.4% South East England MU: 4.5%		
Dogger Bank South East (Dogger Bank South Offshore Wind Farms, 2025)	Maximum spatial scenario	Piling (monopile)	355.4	Not provided	Wider MU: 0.63% South East England MU: 1.16%	Low	
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West, Dogger Bank		Not provided	Wider MU: 2.4% South East England MU: 4.5%		

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
		South East and offshore export cable corridor)				

* As mentioned within Paragraph 10.12.17 these projects were not included within the iPCoD modelling for marine mammals.

- 10.12.57 Results of the cumulative iPCoD modelling for grey seal demonstrate there is only a minor difference between the impacted and un-impacted scenarios, with both showing an increase in population size (Figure 10.32).
- 10.12.58 At time-point 26 (2053) (the final year modelled), 20 years after the end of piling at the Array Area, the difference between impacted and Un-impacted populations is 189 animals (which equates to 0.36% of the UK portion of the MU reference population. The median counterfactual of population size at time-point 26 was one, while the mean counterfactual was 0.997 (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report).

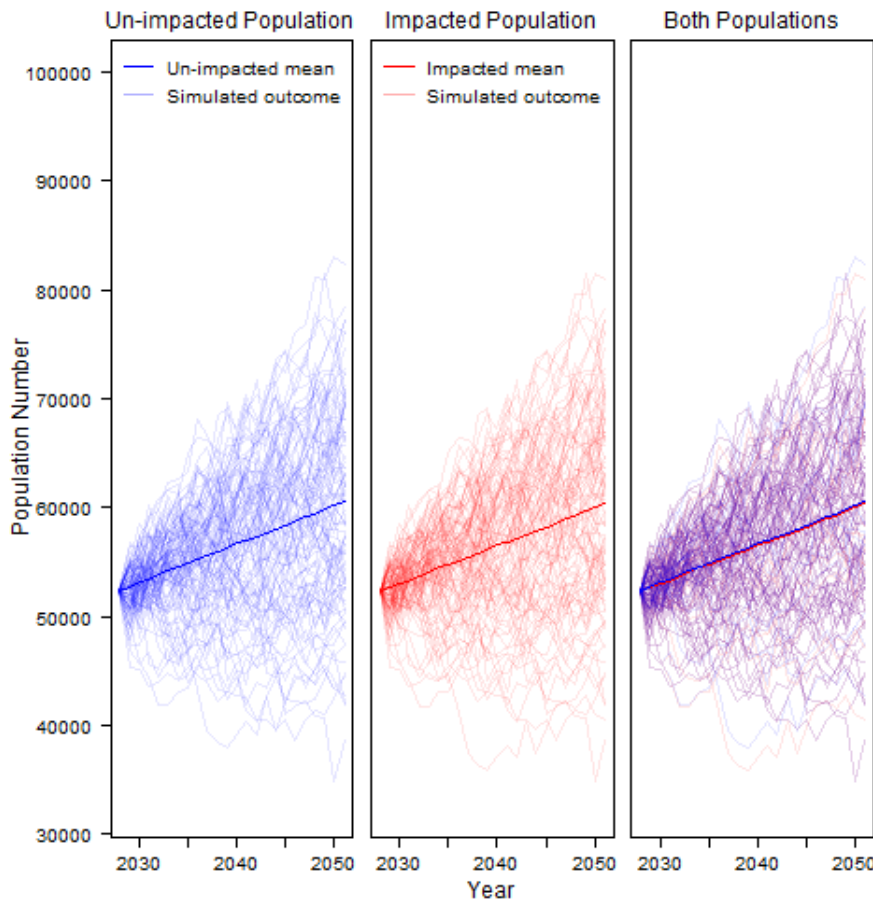


Figure 10.32: Simulated Grey Seal Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario

- 10.12.59 Given that the difference in the impacted to un-impacted populations approaches a median ratio of one throughout, there is considered to be no potential for a long-term population-level effect from this cumulative piling scenario upon grey seal
- 10.12.60 The cumulative impact (due to elevated subsea noise arising during piling) is predicted to be of limited scale in the context of the proportion of the reference population. Short-term or temporary effects in a small proportion of the reference population. Whilst there may be effects at an individual level, these would not be at a scale that would lead to any measurable population-level effects above natural variation. The magnitude is therefore considered to be low.

Sensitivity of Receptor

- 10.12.61 The sensitivity of the receptor is as defined in Paragraphs 10.10.106 *et seq* above for the Project alone assessment.
- 10.12.62 The grey seal is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the grey seal is conservatively considered to be low.

Significance of Effect

- 10.12.63 Overall, the magnitude of the cumulative impact is deemed to be low, and the sensitivity of the receptor is considered to be low. The significance conclusion is therefore Negligible to Minor, due to the level of over-precaution in the assessment of impacts due to disturbance, the effect is concluded to be of **Negligible** adverse significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.64 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not considered to be significant in EIA terms.

Harbour Seal

Magnitude of Impact

- 10.12.65 Table 10.74 presents compiled information on the predicted effects from Tier 2 included in the cumulative assessment for harbour seal.

Table 10.74: Harbour Seal Number of Animals Disturbed for the CEA as a Result of Subsea Noise generated during piling

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
Proposed Development (Section 10.10)	Maximum spatial scenario	Piling	9	Moray Firth SMU and the East Scotland SMU: 0.64%		Low
		OSP				
	Maximum temporal scenario	Piling	8	Moray Firth SMU and the East Scotland SMU: 1.22%		
		OSP				
Berwick Bank OWF (SSE Renewables, 2022)	Maximum spatial scenario	Piling/OSP	3	0.021%		Low
	Maximum temporal scenario	Piling	3	0.021%		
		OSP	1	0.010%		
Muir Mhòr OWF (Muir Mhòr Offshore Wind Farm, 2024)	Maximum temporal scenario	Piling	1	0.27%		Negligible
		OSP	1			
Aspen OWF (Cerulean Winds Aspen Project Limited, 2025)	Maximum spatial scenario	Piling (single anchor)	<1	<0.01%		Negligible
		OSP (jack pile driving)	<1	<0.01%		
MarramWind OWF*	Maximum design scenario	Piling (floating)	17 (East Scotland SMU specific)	East Scotland SMU: 4.41%		Low
Caledonia OWF South (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling	Moray Firth SMU: 75 North Coast and Orkney MU: 54 East Coast MU: <1	Moray Firth SMU: 7.83% North Coast and Orkney MU: 3.39% East Coast MU: <0.27%		Low
		Piling (jacket)	Moray Firth SMU: 58	Moray Firth SMU: 6.05% North Coast and Orkney MU: 2.70%		

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
	Maximum temporal scenario		North Coast and Orkney MU: 43 East Coast MU: 1	East Coast MU: <0.27%		
		Piling (anchor)	Moray Firth SMU: 39 North Coast and Orkney MU: 6 East Coast MU: 1	Moray Firth SMU: 4.07% North Coast and Orkney MU: 0.38% East Coast MU: <0.27%		
Caledonia OWF North (Caledonia OWF Limited, 2024)	Maximum spatial scenario	Piling (monopile)	Moray Firth SMU: 63 North Coast and Orkney MU: 95 East Coast MU: <1	Moray Firth SMU: 6.58% North Coast and Orkney MU: 5.97% East Coast MU: <0.27%		
	Maximum temporal scenario	Piling (jacket)	Moray Firth SMU: 53 North Coast and Orkney MU: 86 East Coast MU: <1	Moray Firth SMU: 5.53% North Coast and Orkney MU: 5.41% East Coast MU: <0.27%		
Ayre OWF*	Maximum spatial scenario	Piling & OSP (floating)	57	North Coast and Orkney and Moray Firth SMU: 1.96%		Low
	Maximum temporal scenario	Piling & OSP (two floating foundations)	81	North Coast and Orkney and Moray Firth SMU: 2.79%		
Dogger Bank South West (Dogger Bank South Offshore Wind Farms, 2025)	Maximum spatial scenario	Piling (monopile)	2	Not provided	South East England MU: 0.04%	Negligible
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West, Dogger Bank South East and	7.3	Not provided	South East England MU: 0.15%	

Project	Scenario	Foundation type	Maximum Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Magnitude as presented in EIA
		offshore export cable corridor)				
Dogger Bank South East (Dogger Bank South Offshore Wind Farms, 2025)	Maximum spatial scenario	Piling (monopile)	3.3	Not provided	South East England MU: 0.07%	Negligible
	Maximum temporal scenario	Piling (monopile at Dogger Bank South West, Dogger Bank South East and offshore export cable corridor)	7.3	Not provided	South East England MU: 0.15%	

* As mentioned within Paragraph 10.12.17 these projects were not included within the iPCoD modelling for marine mammals.

10.12.66 Results of the cumulative iPCoD modelling for harbour seal (Figure 10.33) demonstrate whilst there is potential for a small short-term impact between the impacted and un-impacted scenarios (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report), the modelled populations show recovery from 2038 and a stable trajectory. Across the modelled time the difference between mean impacted and un-impacted population sizes was between zero to two animals throughout (which equates to 0.15% of the combined SMUs reference population). The median counterfactual of population size at time-point 26 was one, while the mean counterfactual was 0.99 (see Volume 3, Technical Appendix 10.3: Marine Mammal iPCoD Modelling Report).

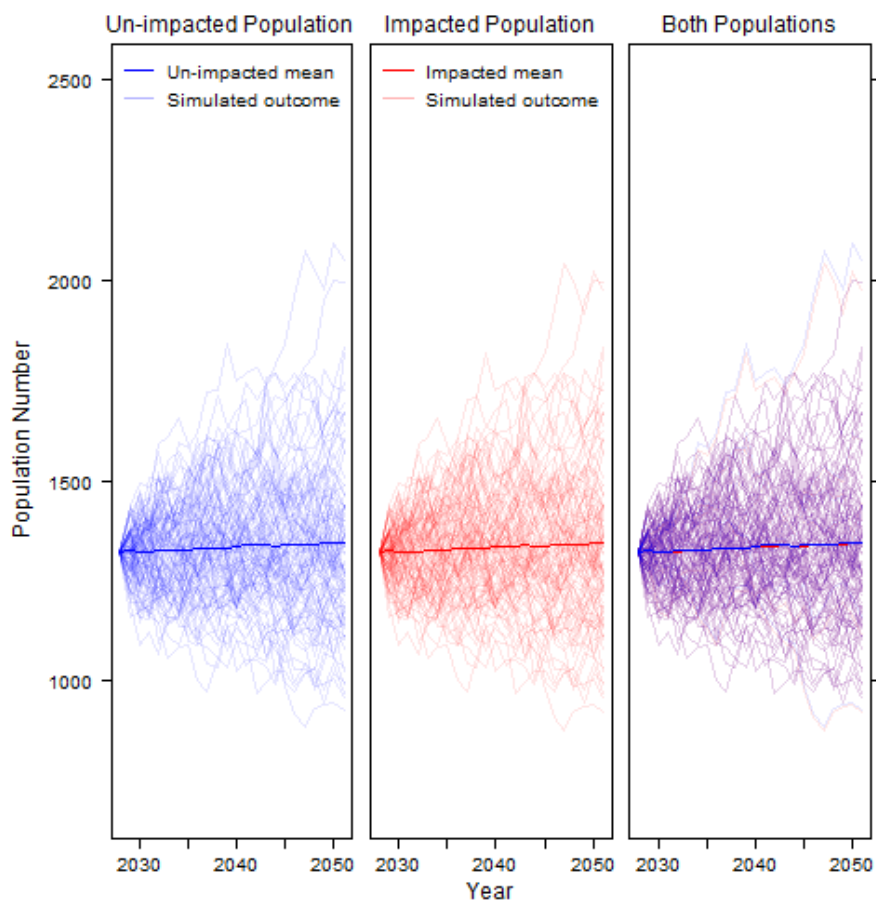


Figure 10.33: Simulated Harbour Seal Population Trajectories in an Un-impacted Versus Impacted Population, for the Cumulative Scenario

10.12.67 Given that the difference in the impacted to un-impacted populations approaches a median ratio of one throughout, there is considered to be no potential for a long-term population-level effect from the cumulative piling scenario upon harbour seal.

10.12.68 The cumulative impact (due to elevated subsea noise arising during piling) is predicted to be of limited scale in the context of the proportion of the reference population. Short-term or temporary effects in a small proportion of the reference population. Whilst there may be effects at an individual level, these would not be at a scale that would lead to any measurable population-level

effects above natural variation. The magnitude is therefore considered to be low.

Sensitivity of Receptor

10.12.69 The sensitivity of the receptor is as defined in Paragraphs 10.10.106 *et seq* above for the Project alone assessment.

10.12.70 The harbour seal is deemed to have some adaptability (avoidance behaviour) and limited tolerance to disturbance, with the ability to recover (recoverability). The sensitivity of the harbour porpoise is conservatively considered to be low.

Significance of Effect

10.12.71 Overall, the magnitude of the cumulative impact is deemed to be low, and the sensitivity of the receptor is considered to be low. The significance conclusion is therefore Negligible to Minor, due to the level of over-precaution in the assessment of impacts due to disturbance, the effect is concluded to be of **Negligible** adverse significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.12.72 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not considered to be significant in EIA terms.

Risso's Dolphin, Fin Whale and Humpback Whale

10.12.73 Risso's dolphin, Fin whale and humpback whale have been assessed qualitatively in relation to the cumulative impact (due to elevated subsea noise arising during piling. For Risso's dolphin, the significance of effect is expected to be similar to that of bottlenose dolphins and white-beaked dolphins. Fin whale and humpback whale are anticipated to be affected in a similar way to minke whales.

Tier 3

Construction Phase

Magnitude of Impact

10.12.74 Alongside the Tier 2 projects, there were nine Tier 3 projects identified with the potential for cumulative impacts associated with subsea noise generated during piling:

- Morven North OWF Array (construction phase);
- Morven South OWF Array (construction phase);
- Bellrock OWF (construction phase);
- Buchan OWF (construction phase);
- Stromar OWF (construction phase);
- Dogger Bank D (construction phase);
- Arven OWF (construction phase);
- Stoura Offshore Wind (construction phase); and
- Fraserburgh Harbour Development (construction) (Table 10.65).

- 10.12.75 As Tier 3 projects, only scoping documents are publicly available, therefore detailed subsea noise modelling results could not be used to inform the cumulative magnitude of impact. Given the nature of each of the Tier 3 projects, it is likely that full subsea noise modelling will be undertaken to assess the potential impacts associated with piling.
- 10.12.76 Refined construction dates for the Tier 3 projects are currently unknown, however the preliminary construction periods presented in Table 10.66 suggest that there may be some overlap with the Proposed Development and Tier 2 projects.
- 10.12.77 At the time of writing, it is not possible to assess the cumulative impact of Tier 3 projects quantitatively, therefore the magnitude, sensitivity and significance of effect remain the same as detailed for the Tier 2 projects above.

INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING UXO CLEARANCE

Tier 2

Construction Phase

Magnitude of Impact

- 10.12.78 As detailed in Table 10.65, there were three Tier 2 projects identified with the potential for cumulative impact associated with UXO clearance:
- Ossian OWF (in construction phase);
 - Berwick Bank OWF (in construction phase); and
 - Aspen OWF (in construction phase).
- 10.12.79 The UXO clearance parameters for these projects, alongside those of the Proposed Development, are presented in Table 10.75. For the Ossian OWF, the type, size and number of possible UXO items as well as exact duration of UXO clearance operations is published within the EIA marine mammal chapter (in 2024). A total of 15 UXOs is the maximum number to be encountered within the Ossian OWF and it is the aim of Ossian OWF to use a donor charge for low order deflagration (0.25 kg) where possible, but for the maximum design assessment high order clearance was assessed (Ossian OWFL, 2024).
- 10.12.80 At the Berwick Bank OWF, where any UXO clearance required this would be undertaken using low order clearance with all efforts being made to avoid high order clearance where possible (Berwick Bank OWF, 2023). However, the potential for high order clearance was assessed to provide a maximum design assessment, with a maximum high order clearance of 300 kg (Table 10.75) (Berwick Bank OWF, 2023).
- 10.12.81 For the Aspen OWF the number of possible UXO items as well as exact duration of UXO clearance operations was not known at the time the Offshore EIA Reports were published (2025). For OWFs a detailed UXO survey will be completed prior to construction. It will be provided as a part of a separate licensing process post-consent when detailed survey data is available (Cerulean Winds Aspen Project Limited, 2025).

10.12.82 For Aspen OWF a review of recent information was undertaken to define the design envelope for UXO with the EIA (Cerulean Winds Aspen Project Limited, 2025). The maximum number of UXOs (to be provided post-consent) to be encountered within the Aspen OWF and the high order clearance (907 kg) will result in the greatest potential impact (Cerulean Winds Aspen Project Limited, 2025).

Table 10.75: UXO Clearance Parameters Incorporated into the MDSs of the Tier 2 Projects

Project	MDS for UXO Clearance	Donor Charge Size (kg)	Maximum UXO Size Modelled (kg)	Maximum Number of UXOs to be Cleared	Duration	Reference
Proposed Development	High order	0.08	720	40	Up to two clearance events within 24 hours, with a maximum of 40 days	Table 10.66
Ossian OWF	High order	0.25	698	15	Up to two clearance events within 24 hours	Ossian OWFL (2024)
Berwick Bank OWF	High order	0.8	300	70	Up to two clearance events within 24 hours, with a maximum of 70 days	Berwick Bank OWF (2024)
Aspen OWF	High order	0.5	907	Unknown	Unknown	Aspen OWF (2025)

Auditory Injury

10.12.83 The subsea noise modelling conducted for the Proposed Development alone and the Tier 2 projects demonstrated that the UXO clearance parameters outlined in Table 10.75 could result in auditory injury for marine mammals, out to a maximum of 14.23 km (peak SPL) for harbour porpoise (Table 10.53). The auditory injury ranges, potential number of animals impacted, and subsequent percentage of the reference MU populations potentially impacted were highest for the Proposed Development, Ossian OWF and Aspen OWF for the majority of species, than for the other Tier 2 projects (Table 10.76). Most likely because the maximum UXO size modelled was the greatest (698 kg and 907 kg compared to 300 kg for Berwick Bank OWF).

- 10.12.84 For the Ossian OWF, the auditory injury (PTS-onset) range for high order clearance was modelled as similar in size to the Project Development for all species with a maximum impact range of 14.54 km (for harbour porpoise) (Table 10.76) (Ossian OWFL, 2024). The maximum number of animals across all species and both metrics estimated to experience auditory injury was modelled as up to 433 individuals which was 0.12% of the relevant MU population (for harbour porpoise) (Table 10.76) (Ossian OWFL, 2024). The remaining impact ranges from the Ossian OWF were all under 4 km, with the second largest impact range of 3.9 km for minke whale, which had an estimated 2 animals with the potential to experience auditory injury (Table 10.76) (Ossian OWFL, 2024). This was followed by grey seal, which had a maximum impact range of 2.85 km, with an estimated 5 animals with the potential to experience auditory injury of the East Scotland and North-east England SMUs (Ossian OWFL, 2024).
- 10.12.85 For the Berwick Bank OWF, modelling of the maximum design high order UXO clearance (300 kg UXO) indicated that the greatest impact would occur for harbour porpoise, with a range of impact of 10.63 km and the potential for auditory injury for 293 harbour porpoise, this was followed by grey seal with a much smaller range of approximately 2 km and for 16 animals, this equates to 0.12% and 0.04% of the relevant MU population for those species, respectively (SSE Renewables, 2022) (Table 10.76). For all other species, auditory injury was predicted to affect less than one individual per species (Table 10.76). For low order deflagration, auditory injury was predicted to affect less than one individual for all assessed species except harbour porpoise which had a maximum of four animals (SSE Renewables, 2022).
- 10.12.86 For Aspen OWF the maximum UXO size modelled was the largest out of all Tier 2 projects, including the Project Development (907 kg) and the auditory injury (PTS-onset) range for high order clearance indicated that the greatest impact would occur for harbour porpoise, even with a higher weight of ordnance the range of impact was only slightly higher than Berwick Bank OWF, at 15 km and the potential for auditory injury for 424 individuals which was 0.27% of the UK portion of the relevant MU and 0.12% of the total relevant MU (Cerulean Winds Aspen Project Limited, 2025) (Table 10.76). For all other species, auditory injury was predicted to affect one individual per species, except for dolphin species which was less than one individual (Table 10.76). For low order deflagration, auditory injury was predicted to affect less than one individual for all assessed species except for harbour porpoise which had a maximum of two animals (Cerulean Winds Aspen Project Limited, 2025).

Risso's dolphin were expected to have similar impact ranges to the HF hearing group species (Southall *et al.*, 2019), which were been grouped into 'dolphin species' in the quantitative assessment for the Tier 2 projects (Table 10.76). Fin whale and humpback whale were expected to have similar impact ranges as minke whale, as both species are within the LF hearing group (Southall *et al.*, 2019) and were not assessed quantitatively by the Tier 2 projects due to uncertainties around density estimates and population sizes (Ossian OWFL, 2024; SSE Renewables, 2022), which aligns with the approach for the Proposed Development alone.

Table 10.76: Maximum Number of Animals with the Potential to Experience Auditory Injury Due to UXO Clearance for the Tier 2 Projects

Species	Project	Range of Impact (km)	Estimated Number of Animals with the Potential to Experience Auditory Injury	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Reference
Harbour porpoise	Proposed Development	14.23	404	0.25%	0.12%	Section 10.10
	Ossian OWF	14.54	433	not provided	0.12%	Ossian OWFL (2024)
	Berwick Bank OWF	10.63	293	not provided	0.08%	SSE Renewables (2022)
	Aspen OWF	15	424	0.27%	0.12%	Aspen OWF (2025)
Dolphin species	Proposed Development	0.83	<1	<0.01% to 0.01% depending on species	<0.01%	Section 10.10
	Ossian OWF	0.84	<1	<0.01	<0.01	Ossian OWFL (2024)
	Berwick Bank OWF	0.62	<1	<0.01%	<0.01%	SSE Renewables (2022)
	Aspen OWF	0.88	<1	<0.01	<0.01	Aspen OWF (2025)
Minke whale	Proposed Development	4.12	2	0.02%	<0.01%	Section 10.10
	Ossian OWF	3.93	2	not provided	0.01%	Ossian OWFL (2024)
	Berwick Bank OWF	4.18	<1	not provided	not provided	SSE Renewables (2022)
	Aspen OWF	12	2	0.02%	0.01%	Aspen OWF (2025)

Species	Project	Range of Impact (km)	Estimated Number of Animals with the Potential to Experience Auditory Injury	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected	Reference
Grey seal	Proposed Development	1.68	5	0.01%		Section 10.10
	Ossian OWF	2.85	5	0.01%		Ossian OWFL (2024)
	Berwick Bank OWF	2.09	16	0.04%		SSE Renewables (2022)
	Aspen OWF	3	<1	<0.01		Aspen OWF (2025)
Harbour seal	Proposed Development	1.68	<1	<0.01%		Section 10.10
	Berwick Bank OWF	2.09	<1	0.08%		SSE Renewables (2022)
	Aspen OWF	3	<1	<0.01%		Aspen OWF (2025)

- 10.12.87 Whilst injury from UXO clearance is a permanent change in the hearing threshold and affected animals will not recover that portion of their hearing range, a very low number of animals are predicted to be affected by the Tier 2 projects. This will be further reduced using Embedded Mitigation measures. Further, the impact is expected to be short-term and intermittent (tens of days for each project).
- 10.12.88 The subsea noise modelling undertaken for the Proposed Development and the Tier 2 projects assumes that no mitigation has been used, therefore, no prior deterrence of animals from the impact area. However, as part of the outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) which is an Embedded Mitigation for the Proposed Development and the Tier 2 projects, measures such as ADD's to deter animals from the area prior to works commencing have been proposed, to reduce the potential risk of auditory injury. Therefore, the number of animals which are predicted to experience auditory injury from UXO clearance is likely to be an overestimate (Ossian OWFL, 2024; SSE Renewables, 2022).
- 10.12.89 UXO clearance at each of the Tier 2 projects will occur as a discrete stage within their overall construction phases and therefore will not coincide continuously over the duration of temporal overlap. Furthermore, each UXO clearance will result in a very short duration of noise emission (i.e. seconds), therefore temporal overlap is unlikely.
- 10.12.90 For bottlenose dolphin, Risso's dolphin, white-beaked dolphin, minke whale, fin whale, humpback whale, harbour seal and grey seal, the cumulative impact is predicted to be of local spatial extent (in terms of modelled ranges), short-term duration, intermittent and low reversibility (if auditory injury occurs). It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.
- 10.12.91 To reflect the relative greater number of harbour porpoise predicted to be at risk, the magnitude is considered to be low.
- Behavioural Disturbance (TTS As A Proxy)***
- 10.12.92 For this impact TTS has been applied as a proxy for strong disturbance although noting that TTS onset could potentially result in a temporary reduction in hearing. Whilst some behaviours (e.g. feeding, communication, socialisation) could be inhibited in the short-term these are reversible and therefore not considered likely to lead to any long-term effects on the individual. As discussed in Paragraph 10.12.89, the duration of effect for each UXO detonation is less than one second and therefore behavioural effects are considered to be negligible in this context.
- 10.12.93 The subsea noise modelling (Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report) conducted for the Proposed Development alone and the Tier 2 projects demonstrated that the UXO clearance parameters outlined in Table 10.77 could result in behavioural disturbance for marine mammals, in the order of tens of kilometres, depending on species.

- 10.12.94 For the Ossian OWF, subsea noise modelling for the maximum design high order UXO clearance (698 kg UXO, plus a 0.25 kg donor charge) predicted that harbour porpoise (1,467 individuals) and minke whale (111 individuals) would be subject to the greatest disturbance impact from UXO clearance, which is equivalent to 0.42% and 0.47% of the MU population for those species, respectively (Table 10.77) (Ossian OWFL, 2024). For all other species, the maximum TTS onset range equated to less than 0.1% of the MU populations potentially impacted. The impact range and the number of animals predicted to be disturbed by low order clearance, which is the preferred method where possible, was very low for all species except for harbour porpoise which was a maximum of 13 animals (1,454 less individuals than high order UXO clearance) (Ossian OWFL, 2024).
- 10.12.95 For the Berwick Bank OWF, subsea noise modelling for the maximum design high order UXO clearance (300 kg UXO, plus a 0.8 kg donor charge) predicted that harbour porpoise (995 individuals) would be subject to the greatest disturbance impact from UXO clearance, which is equivalent to 0.29% of the MU population for those species (Table 10.77) (SSE Renewables, 2022). For all other species, the maximum TTS onset range equated to less than 0.1% of the MU populations potentially impacted or was not provided. The impact range and the number of animals predicted to be disturbed by low order clearance, which is the preferred method where possible, was very low for all species except for harbour porpoise which was a maximum of 25 animals (970 less individuals than high order clearance) (SSE Renewables, 2022).
- 10.12.96 For the Aspen OWF, a 26 km EDR was used alongside TTS onset thresholds (Southall *et al.*, 2019) to model behavioural disturbance (Cerulean Winds Aspen Project Limited, 2025). The largest ranges and numbers of animals potentially impacted were those associated with the 5 km EDR and have been presented in. with the greatest number of individuals estimated for grey seal with up to 29 individuals affected). Low order clearance may also disturb up to 22 harbour porpoise and 11 white-beaked dolphins. For all other species, the maximum number of individuals potentially disturbed have been estimated as very low for all species (maximum of one animal, and <0.01% of the MU population for each species) (Cerulean Winds Aspen Project Limited, 2025).

Table 10.77: Maximum Number of Animals with the Potential to Experience Behavioural Disturbance (TTS) due to UXO Clearance for the Tier 2 Projects

Species	Project	Range of Impact (km)	Estimated Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected
Harbour porpoise	Proposed Development	26.23	1,373	0.86%	0.4%
	Ossian OWF	26.79	1,467	Not provided	0.42%
	Berwick Bank OWF	19.59	995	Not provided	0.29%
	Aspen OWF	28	1,475	0.92%	0.43%
Dolphin species	Proposed Development	1.60	Between <1 (bottlenose dolphin) to 2 (white-beaked dolphin)	<0.01%	<0.01%
	Ossian OWF	1.55	<1	Not provided	Not provided
	Berwick Bank OWF	1.14	Between <1 (bottlenose dolphin) and 1 (white-beaked dolphin)	Not provided	Not provided
	Aspen OWF	1.6	Between 2 (white-beaked dolphin) and <1 (bottlenose dolphin)	White-beaked dolphin: <0.01% Bottlenose dolphin: 0.41%	White-beaked dolphin: <0.01% Bottlenose dolphin: <0.01%
Minke whale	Proposed Development	34.28	111	1.09%	0.55%
	Ossian OWF	32.74	96	Not provided	0.47%
	Berwick Bank OWF	34.14	142	Not provided	0.07%
	Aspen OWF	4.9	6	0.06%	0.03%
Grey seal	Proposed Development	8.79	136	0.26%	
	Ossian OWF	6.12	22	0.06%	
	Berwick Bank OWF	6.43	156	Not provided	
	Aspen OWF	24	2	0.03%	
Harbour seal	Proposed Development	8.79	3	0.16%	

Species	Project	Range of Impact (km)	Estimated Number of Animals Potentially Disturbed	Percentage of UK Portion of the MU Population Potentially Affected	Percentage of Whole MU Population Potentially Affected
	Berwick Bank OWF	6.43	<1	Not provided	
	Aspen OWF	24	2	0.03	

* An EDR was used for this high-ordnance modelling

10.12.97 The maximum design predictions are all based on high order clearance methods. It is anticipated that all other projects will adhere to current guidance (Scottish Government, 2025) which states that low noise methods of clearance should be the default.

10.12.98 For all species, the cumulative impact is predicted to be of local spatial extent (in terms of modelled ranges), short-term duration, intermittent and both the impact itself (i.e. the elevation in subsea noise during detonation event) and effect of disturbance is reversible (onset of TTS represents a non-trivial disturbance but not permanent injury). The magnitude is therefore, considered to be low.

Sensitivity of Receptor

10.12.99 The sensitivity of the receptor is as defined in Paragraphs 10.10.153 *et seq.* above for the Project alone assessment.

Auditory Injury

10.12.100 All receptors are deemed to have limited resilience to auditory injury, low recoverability and adaptability. The sensitivity of the receptor is therefore considered to be high.

Behavioural Disturbance (TTS As A Proxy)

10.12.101 All species considered are deemed to have the ability to avoid or adapt behaviour, some tolerance (resilience) to behavioural disturbance and high recoverability. The sensitivity of all species to behavioural disturbance is therefore, considered to be low.

Significance of Effect

Auditory Injury

10.12.102 Although the default approach is the use of low order techniques for UXO clearance (Table 10.30), the conclusions presented are based on the assessment for high order clearance, which therefore presents a conservative assumption of project parameters.

10.12.103 For bottlenose dolphin, white-beaked dolphin, minke whale, fin whale, humpback whale, harbour seal and grey seal, overall, the magnitude of the cumulative effect is deemed to be negligible, and the sensitivity of all receptors is considered to be high. The cumulative effect will, therefore, be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

10.12.104 For harbour porpoise the magnitude of the cumulative effect with Embedded Mitigation measures is deemed to be low and the sensitivity of the receptor is considered to be high. Although the significance conclusion is Minor to Moderate the cumulative effect conclusion is of **Moderate** adverse significance on a precautionary basis, which is not significant in EIA terms. Additional Mitigation and residual significance are discussed in Paragraph 10.12.107 *et seq.*

Behavioural Disturbance (TTS As A Proxy)

- 10.12.105 As described for auditory injury, the conclusion presented is based on the assessment for high order clearance.
- 10.12.106 Overall, the magnitude of the cumulative effect is deemed to be low for all species, and the sensitivity of all receptors is considered to be low. Although the significance conclusion is Negligible or Minor the cumulative effect will, be of **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

Auditory Injury

- 10.12.107 For all species excluding harbour porpoise, no Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.
- 10.12.108 However, Embedded Mitigation include the adherence to a MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). The specific mitigation measures will be tailored once a more detailed understanding of the size and number of UXO is available and will be discussed with stakeholders and proposed as part of the final MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol).

Behavioural Disturbance (TTS As A Proxy)

- 10.12.109 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Tier 3

Construction Phase

Magnitude of Impact

- 10.12.110 In addition to the Tier 2 projects, there were four Tier 3 projects identified with the potential for cumulative impact associated with UXO clearance:
- Morven North OWF Array (construction);
 - Morven South OWF Array (construction phase);
 - Morven Hawthorn Pit Grid Connection Project (construction); and
 - Ossian Transmission Infrastructure (construction) (Table 10.66).
- 10.12.111 As Tier 3 projects, only scoping documents are publicly available, therefore detailed subsea noise modelling results could not be used to inform the cumulative magnitude of impact. UXO clearance has been scoped in for further assessment in the Scoping Reports for all Tier projects.
- 10.12.112 Refined construction dates for the Tier 3 projects are currently unknown, however the preliminary construction periods presented in Table 10.67 suggest that there may be some overlap with the Proposed Development and Tier 2 projects. However, as detailed in Paragraph 10.12.89 for the Tier 2 assessment, the duration of effect for each UXO detonation is less than one second and

therefore, the potential for realistic temporal overlap in UXO detonations is considered to be negligible in this context.

10.12.113 It is expected that the risk of auditory injury will be reduced by standard industry measures (including visual and acoustic monitoring) at the Tier 3 projects. The cumulative risk is therefore expected to be minimised as a result.

10.12.114 At the time of writing, it is not possible to assess the cumulative impact of Tier 3 projects, therefore the magnitude, sensitivity and significance of effect remain the same as detailed for the Tier 2 projects above.

INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED DURING SITE- INVESTIGATION SURVEYS

10.12.115 The risk of auditory injury due to subsea noise from site-investigation surveys would be expected to be localised to within the boundaries of the respective projects. The subsea noise modelling assessment for the Proposed Development alone demonstrated that the maximum auditory injury impact range was 251 m for geophysical surveys (for SSS, based on harbour porpoise) with thresholds not exceeded for any hearing group due to geotechnical surveys. Further, injury thresholds were lower and/or not exceeded for other hearing groups and other geophysical survey equipment. These highly localised potential injury ranges resulted in very low numbers of animals potentially impacted (see Section 10.10). Furthermore, any risk of injury will be mitigated via the Outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) (Section 10.9) and therefore the potential for cumulative injury is unlikely and not considered further in the cumulative assessment. The cumulative assessment focuses on behavioural disturbance only.

Tier 2

Construction and O&M Phases

Magnitude of Impact

10.12.116 As detailed in Table 10.66, there was two Tier 2 project identified with the potential for cumulative impact associated with site-investigation surveys in the construction and O&M phases of the Proposed Development:

- Ossian OWF (construction and O&M phases); and
- Berwick Bank OWF (construction and O&M phases).

10.12.117 The EIA for the Ossian OWF and Berwick Bank OWF includes the following geophysical surveys assessed:

- MBES (Ossian and Berwick Bank);
- SSS (Ossian and Berwick Bank);
- SBES (Berwick Bank);
- SBP (Ossian and Berwick Bank); and
- 2D UHRS (Ossian and Berwick Bank).

10.12.118 The EIA for the Ossian OWF and Berwick Bank OWF includes the following geotechnical surveys assessed:

- CPT;
- vibrocore; and
- borehole.

10.12.119 With the addition of box core and piston core for Ossian OWF only.

10.12.120 As for the Proposed Development, the EIA for the Ossian OWF and the Berwick Bank OWF considered site-investigation surveys in the construction and O&M phases (Ossian OWFL, 2024; SSE Renewables (2022)). Therefore, the construction and O&M phases have been combined here to prevent repetition.

Behavioural Disturbance

10.12.121 Noise modelling was also undertaken for both Ossian OWF and Berwick Bank OWF for behavioural disturbance due to site-investigation surveys and are presented below in Table 10.78 and

10.12.122 Table 10.79.

10.12.123 For the Ossian OWF the maximum potential mild disturbance range for impulsive site-investigation surveys (UHRS, CPT) was 1,330 m for CPT and a minimum of 80 m for UHRS (Table 10.78). With no more than one animal at the potential to be disturbed except for harbour porpoise where up to four animals could experience mild disturbance (140 dB 1 μ Pa). In comparison for strong behavioural disturbance (160 dB 1 μ Pa) a maximum range was smaller with 140 m for CPT to 80 m during UHRS, with no more than one animal of each assessed species at risk of experiences strong disturbance. For non-impulsive site-investigation activities (MBES, SSS, SBP, bore drilling and vibrocore) the maximum behavioural ranges are much larger, with 9,101 m for vibrocore to a minimum of 27 m for borehole drilling (Table 10.78). As such, for vibrocore could lead to the disturbance of 170 harbour porpoise, 47 grey seal, 32 white-beaked dolphin, eight minke whale, humpback whale and less than one bottlenose dolphin. There was no overlap of behaviour disturbance ranges with sites important for the relevant species (Ossian OWFL, 2024)

10.12.124 For the Berwick Bank OWF the maximum potential disturbance range for site-investigation surveys was 7,459 m for vibrocore and a minimum of 20 m for boreholes (Table 10.78). This would lead to the potential disturbance of 210 grey seal, 144 harbour porpoise, five bottlenose dolphin and one or less than one animal for harbour seal, white-beaked dolphin and minke whale.

Table 10.78: Disturbance Ranges for Marine Mammals During the Geotechnical Site-Investigation Surveys for the Project Development and Tier 2 Projects

Project	Disturbance Range (m)							
	MBES	SSS	SBES	SBP	UHRS	Borehole	CPT	Vibrocoring
Proposed Development	490	530	n/a	1,275	552	294	n/a	9,154
Ossian OWF	375	320	n/a	1,340	565 (mild), 80 (strong)	27	1,330 (mild), 140 (strong)	9,101
Berwick Bank OWF	865	675	735	2,045	585	20	1,500	7,459

Table 10.79: Number of Animals with the Potential to be Disturbed During Geophysical and Geotechnical Site-Investigation Surveys for the Project Development and Tier 2 Projects

Species	Project	Estimated number of Animals with the Potential to Experience Injury (PTS)							
		Geophysical surveys						Geotechnical surveys	
		MBES	SSS	SBE	SBP	UHRS	Borehole drilling	CPT	Vibrocoring
Harbour Porpoise	Proposed Development	<1	<1	N/A	4	<1	<2	N/A	167
	Ossian OWF	<1	<1	N/A	<1	<1 (<1)	N/A	<1 (<1)	N/A
	Berwick	2	1	1	11	1	<1	6	144
Bottlenose Dolphin	Proposed Development	<1	<1	N/A	<1	<1	<1	N/A	2
	Ossian OWF	<1	<1	N/A	<1	N/A	N/A	N/A	N/A
	Berwick	<1	<1	<1	<1	<1	<1	<1	5
White-beaked Dolphin	Proposed Development	<1	<1	N/A	<1	<1	<1	N/A	2
	Ossian OWF	<1	<1	N/A	<1	N/A	N/A	N/A	N/A
	Berwick	<1	<1	<1	<1	<1	<1	<1	<1
Minke Whale	Proposed Development	<1	<1	N/A	<1	<1	<1	N/A	8
	Ossian OWF	<1	<1	N/A	<1	N/A	N/A	N/A	N/A
	Berwick	<1	<1	<1	<1	<1	<1	<1	1
Grey Seal	Proposed Development	<1	<1	N/A	3	<1	<1	N/A	148
	Ossian OWF	<1	<1	N/A	<1	N/A	N/A	N/A	N/A
	Berwick	3	2	2	16	1	<1	8	210
Harbour Seal	Proposed Development	<1	<1	N/A	<1	<1	<1	N/A	3
	Berwick	<1	<1	<1	<1	<1	<1	<1	1

- 10.12.125 However, both the Ossian OWF and Berwick Bank OWF EIA concluded that the majority of acoustic energy will be directed at the seabed rather than being emitted horizontally, which reduces the impacts of noise emissions on nearby marine mammals (Ossian OWFL, 2024; SSE Renewables, 2022).
- 10.12.126 Furthermore, for the Proposed Development and the Ossian OWF and Berwick Bank OWF, site-investigation surveys are anticipated to be short-term in nature (weeks to a few months) for their construction phases and occur intermittently over their O&M phases.
- 10.12.127 Overall, for all marine mammal species, the cumulative impact is predicted to be of local spatial extent, short-term duration, intermittent, and high reversibility (with animals returning to baseline levels soon after surveys have ceased). It is predicted that the impact will affect the receptor directly. Whilst there may be effects at an individual level, these are not predicted to be at a scale that would lead to any population-level effects. The magnitude is therefore, considered to be low.

Sensitivity of Receptor

- 10.12.128 The sensitivity of the receptor is as defined in Paragraphs 10.10.196 *et seq.* above for the Project alone assessment.
- 10.12.129 All species considered are deemed to have the ability to avoid or adapt behaviour, some tolerance (resilience) to behavioural disturbance and high recoverability. The sensitivity of all species to behavioural disturbance is therefore, considered to be low.

Significance of Effect

- 10.12.130 Overall, for all receptors, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be low. The effect will therefore be of Negligible or Minor adverse significance, the conclusion is **Minor** on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.131 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Tier 3

Construction Phase

Magnitude of Impact

- 10.12.132 As detailed in Table 10.66, alongside the Tier 2 project, there were four Tier 3 projects identified with the potential for cumulative impact associated with site-investigation surveys:
- Morven North OWF Array (construction and O&M phases);
 - Morven South OWF Array (construction and O&M phases);
 - Morven Hawthorn Pit Grid Connection Project (construction and O&M phases); and
 - Ossian Transmission Infrastructure (construction and O&M phases).

- 10.12.133 As a Tier 3 project, only a Scoping Report is available in the public domain. Within the Morven OWF Arrays, Morven Hawthorn Pit Grid Connection Project and Ossian Transmission Infrastructure Scoping Report, geophysical surveys were proposed to be scoped into the assessment in the construction phase (Morven Offshore Wind Limited, 2023; Morven Hawthorn Pit Grid Connection Project, 2025; Ossian OWF: Transmission Infrastructure, 2025). Geophysical surveys were not scoped into the O&M phase, and therefore the Tier 3 assessment focuses on the construction phase only. Lower potential disturbance ranges were modelled for the Proposed Development for geophysical surveys compared to geotechnical surveys (Section 10.10), which further reduces the potential for cumulative effects.
- 10.12.134 As for the Tier 3 assessment, site-investigation surveys are anticipated to be short-term in nature (weeks to a few months) for the construction phase of the Morven North OWF Array, Morven South OWF Array, Morven Hawthorn Pit Grid Connection Project and Ossian Transmission Infrastructure.
- 10.12.135 The Tier 3 Projects are therefore not likely to affect the conclusions for Tier 2 projects. The magnitude, sensitivity and significance remain the same as Paragraph 10.10.142.

INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED BY VESSEL USE AND OTHER NOISE PRODUCING ACTIVITIES

- 10.12.136 The risk of auditory injury due to subsea noise from vessel use and other noise producing activities would be expected to be localised to within the boundaries of the respective projects. The noise modelling assessment for the Project alone demonstrated that auditory injury thresholds were not exceeded for any marine mammal hearing group for any vessel type or other noise producing activity (drilled piling, cable laying, cable trenching and cutting, or boulder clearance). The potential for cumulative injury is unlikely and not considered further in cumulative assessment. Therefore, the cumulative assessment focuses on behavioural disturbance only.

Tier 2

Construction and O&M Phases

Magnitude of Impact

- 10.12.137 As detailed in Table 10.66, there were six Tier 2 projects identified with the potential for cumulative impact associated with vessel noise and other noise producing activities in the construction and O&M phases of the Proposed Development:
- Ossian OWF (construction and O&M phases);
 - Berwick Bank OWF (all phases);
 - Seagreen Phase 1A OFTO (O&M and decommissioning phases);
 - Inch Cape OFTO (O&M and decommissioning phases);
 - Berwick Bank OFTO (Cambois Connection)(O&M and decommissioning phases); and

- Eastern Green Link 2 (O&M and decommissioning phases).

- 10.12.138 The EIA for the Ossian OWF included a range of vessels for the construction and O&M phases, with a total of 97 vessels to be present within the Site Boundary and up to 7,902 return trips over construction and a total of up to 30 vessels within the Site Boundary with up to 508 return trips throughout the 35 years of O&M (Ossian OWFL, 2024). Subsea noise modelling was carried out for risk of auditory injury due to vessel noise during construction and concluded that the threshold for PTS was not exceeded for any of the assessed species excluding harbour porpoise (Ossian OWF, 2024). There was a risk of PTS to harbour porpoise within 15 m of the subsea noise for sandwave clearance, main installation vessels, cable laying and rock placement vessels, unlike the Proposed Development where auditory injury was not exceeded for all species (Paragraph 10.10.223). Other noise producing activities for which the risk of auditory injury was modelled during construction was drilled piling, the PTS threshold for all species assessed for Ossian OWF was not exceeded, which was also concluded for the Proposed Development (Ossian OWFL, 2024).
- 10.12.139 The Ossian OWF EIA concluded that for the potential behavioural disturbance range associated with the construction activities the greatest modelled disturbance range was 3,259 m for all marine mammal species and for non-vessel sound 2,224 m from sound wave clearance, cable laying and rock placement activities (Ossian OWFL, 2024). The estimated potential disturbance ranges for boulder clearance, offshore construction vessel, excavator, backhoe dredgers and the non-vessel noise from drilled piles were much smaller at 302 m and 309 m respectively (Ossian OWFL, 2024). This is also seen within the Proposed Development with much smaller ranges for boulder clearance, offshore construction vessels and drilled piling (474 m and 407 m) (Table 10.62). The number of animals which were predicted to experience this behavioural disturbance ranged from 22 animals, for harbour porpoise to six grey seal and four white-beaked dolphin from survey vessels and CTVs, SOVs, support vessels, CSVs, trenching support vessels, UXO clearance vessel, PLGR vessels and DSVs (Ossian OWFL, 2024). The Proposed Development has a similar result with the highest number of animals for disturbance due to vessel use and other subsea noise for harbour porpoise, followed by grey seal and white-beaked dolphin for similar survey types (Table 10.63). The animals which were predicted to experience this behavioural disturbance for less than one animal were bottlenose dolphin and minke whale for all noise source/vessels (Ossian OWFL, 2024).
- 10.12.140 For Ossian OWF these behavioural disturbance ranges don't overlap with any important areas for the species assessed and given that this Tier 2 project is 25.4 km away and there will be no overlap of the projects predicted disturbance ranges with the Proposed Development. As for the Proposed Development the O&M phase of the Ossian OWF the assessment of auditory injury and behavioural disturbance was not reiterated.

- 10.12.141 The Berwick Bank OWF EIA which includes the Berwick Bank OFTO included a range of vessels, similar to those of Ossian OWF and the Proposed Development but had higher vessel numbers and return trips due to the scale of the project (SSE Renewables, 2022). Subsea noise modelling was carried out for risk of auditory injury due to vessel noise during construction and concluded that the threshold for PTS was exceeded for harbour porpoise (a maximum range of 525 m), bottlenose dolphin and white-beaked dolphin (a maximum range of 15 m) and for seal species (at a range of 5 m) this was for rock placement vessels and smaller ranges were concluded for installation and construction vessels (for harbour porpoise and dolphin species only) (SSE Renewables, 2022). Other noise producing activities also had a maximum range of 525 m for harbour porpoise, 15 m for bottlenose dolphin and white-beaked dolphin and 5 m for seal species for cable laying, and for jack-up rig there was an estimated PTS range of 5 m for harbour porpoise only (SSE Renewables, 2022). For minke whale and for all other activities (drilled piling, cable trenching, cable laying and jack-up rig) the thresholds for PTS were not exceeded. Whilst these ranges for potential injury are higher than Ossian and the Proposed Development the number of animals which could be potentially injured using the modelled ranges from vessels and other activities were calculated as less than one animal for all species (SSE Renewables, 2022).
- 10.12.142 The Berwick Bank OWF EIA concluded that for the potential behavioural disturbance range associated with the construction activities the greatest modelled disturbance range was 4,320 m for vessels for all marine mammal species and for non-vessel sound 4,389 m from cable laying (SSE Renewables, 2022). The estimated potential disturbance ranges for excavator, backhoe dredgers, pipe laying, geophysical survey vessel and jack-up vessel and the non-vessel noise from jack-up rig were much smaller at 300 m (SSE Renewables, 2022). The number of animals which were predicted to experience this behavioural disturbance ranged from 70 animals, for grey seal, 48 animals for harbour porpoise and 14 animals for white-beaked dolphin from installation vessel, construction vessel and rock placement vessel (SSE Renewables, 2022). In comparison to Ossian OWF and the Proposed Development the Berwick Bank OWF has a much higher number of grey seal which have the potential to experience disturbance due to vessel subsea noise (Table 10.63). In comparison bottlenose dolphin, minke whale and harbour seal were predicted to experience this behavioural disturbance for less than two animals for all vessel noise and other activities (SSE Renewables, 2022).
- 10.12.143 For Berwick Bank OWF these behavioural disturbance ranges don't overlap with any important areas for the species assessed except potentially offshore populations of bottlenose dolphin. However, given that this Tier 2 project is 56.5 km there will be no overlap of the projects predicted disturbance ranges with the Proposed Development. As for the Proposed Development the O&M phase of the Berwick Bank OWF the assessment of auditory injury and behavioural disturbance was not reiterated.

- 10.12.144 For the Seagreen Phase 1A OFTO for the impact of subsea noise due to vessels and other noise producing activities for all phases was scoped out of assessment with only the assessment of noise emission from geophysical surveys considered (Seagreen Phase 1A Limited, 2021).
- 10.12.145 For the Inch Cape OFTO the impact of disturbance from increased noise (excluding piling and noise associated with geophysical survey) for marine mammal receptors was scoped out as agreed by MS-LOT (Inch Cape Offshore Wind Limited, 2018) in the Scoping Opinion for Inch Cape OFTO during all phases as it was determined that the impact was unlikely to lead to significant effects.
- 10.12.146 For the Berwick Bank OFTO or Berwick Bank Cambois Connection for the impact of subsea noise due to vessels and other noise producing activities for all phases this was scoped out of assessment, this was due the conclusion that because of the nature of the sound and the likelihood that it will be masked by ambient sounds within the marine environment and not present a change from baseline conditions from those already existing within the North Sea (SSE Renewables, 2023).
- 10.12.147 For the Green Eastern Link 2 for the impact of subsea noise due to vessels and other noise producing activities for all phases was scoped out of assessment with only the assessment of noise emission from geophysical surveys considered (The Scottish Government, 2022).
- 10.12.148 Therefore, the Seagreen Phase 1A OFTO, Inch Cape OFTO, Berwick Bank Cambois Connection and the Green Eastern Link 2 are considered no further in the assessment of Tier 2 projects for this impact.
- 10.12.149 Vessel noise and other construction activities will occur intermittently over the duration of the construction phase of the Proposed Development and the Tier 2 projects with vessel noise also occurring intermittently throughout the O&M phases of the Proposed Development and Tier 2 projects. Although animals in the vicinity of the vessels and other noise producing activities may experience behavioural disturbance, they may move away from the activity outside of the Zol.
- 10.12.150 For all species, the impact is predicted to be of local spatial extent, the effect is anticipated to be temporary, at LF, the magnitude is therefore considered to be low.

Sensitivity of the Receptor

- 10.12.151 The sensitivity of the receptor is as defined in Paragraphs 10.10.237 *et seq.* above for the alone assessment.
- 10.12.152 All species are deemed to have some resilience to behavioural disturbance, limited ability to avoid or adapt behaviour to the impact, and high recoverability. The sensitivity of the receptor is therefore, considered to be medium.

Significance of Effect

- 10.12.153 Embedded Mitigation measures adopted as part of the Proposed Development include the development of and adherence to an Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan), which includes adherence by vessels to guidelines laid out in the SMWWC (Table 10.30). The Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan) will include requirements to not deliberately approach marine mammals as a minimum, avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride and to remain at safe speeds at all times and reduce speed when a marine mammal is in the vicinity. Whilst these measures are expected to further reduce the potential risk of injury or disturbance, it is important to note that the assessment of the significance of effect does not take these mitigation measures into account.
- 10.12.154 Overall, for all marine mammal species, the cumulative magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be medium. The cumulative effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.155 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation (beyond the Embedded Mitigation outlined in Section 10.9) is not significant in EIA terms.

Decommissioning Phase

Magnitude of Impact

- 10.12.156 As detailed in Table 10.66, there was two Tier 2 project identified with the potential for cumulative impact associated with vessel noise and other noise producing activities in the decommissioning phase of the Proposed Development:
- Ossian OWF (all phases); and
 - Berwick Bank OWF (all phases).
- 10.12.157 As detailed in Table 10.66, the decommissioning phase of the Ossian OWF is expected from approximately 2072 and the decommissioning phase of Berwick Bank OWF is approximately 2067, with that of the Proposed Development from 2067. Within the EIA for the Ossian OWF and Berwick Bank OWF, disturbance from decommissioning vessels and activities was considered to be equal to or lesser than that presented in Paragraph 10.12.138 to Paragraph 10.12.143 for the construction phase (Ossian OWFL, 2024; SSE Renewables, 2022). Similarly, for the Proposed Development, behavioural disturbance due to subsea noise from these sources in the decommissioning phase was also considered to be lesser than or equal to that of the construction phase (e.g. between 474 m to 5,597 m, depending on the vessel type, and up to 4,540 m for cable laying (Section 10.10)).

- 10.12.158 Vessel noise and decommissioning activities will occur intermittently during the decommissioning phases of the Proposed Development and Berwick Bank OWF. Although animals in the vicinity of the vessels and other noise producing activities may experience behavioural disturbance, they may move away from the activity outside of the ZOI.
- 10.12.159 Vessel noise and other noise producing activities during the decommissioning phase is not likely to affect the conclusions for the assessment for the construction and O&M phase above. The magnitude, sensitivity and significance conclusions remain the same as detailed in Paragraphs 10.12.153 *et seq.*

Tier 3

All Phases

Magnitude of Impact

- 10.12.160 As detailed in Table 10.66, alongside the Tier 2 projects, there were five Tier 3 projects identified with the potential for cumulative impact associated with vessel noise and other noise producing activities with the Proposed Development:
- Morven North OWF Array (in all phases);
 - Morven South OWF Array (in all phases);
 - Morven Hawthorn Pit Grid Connection Project (construction and O&M phases);
 - Ossian Transmission Infrastructure (construction and O&M phases); and
 - CNSE Project (O&M phases).
- 10.12.161 As detailed in Table 10.66, it is possible that the construction, O&M, and decommissioning phases of the Morven North OWF Array, Morven South OWF Array, Morven Hawthorn Pit Grid Connection Project, Ossian Transmission Infrastructure and CNSE Project may overlap with those of the Proposed Development. Given that these are Tier 3 projects, with little information on their construction and decommissioning programmes and operational lifetimes in the public domain, all three phases have been combined here for brevity.
- 10.12.162 For the Morven North OWF Array and Morven South OWF Array joint scoping report, the disturbance to marine mammals from vessel use and other (non-piling) sound-producing activities was scoped in for all phases through a quantitative assessment (Morven Offshore Wind Limited, 2023). The Morven Hawthorn Pit Grid Connection Project scoping report follows the same approach as both of the Morven OWF Arrays, including disturbance to marine mammals from vessel use and other sound-producing activities (such as drilling and trenching) for all phases which will use a quantitative assessment, like the Proposed Development, to quantify the potential numbers of animals injured and or disturbed through modelling underwater sound (Morven Hawthorn Pit Grid Connection Project, 2025). Similarly, in the scoping report for the Ossian Transmission Infrastructure included disturbance due to vessel use and other activities for all phases, but will include a qualitative assessment to cover all

noise producing activities (such as rock placement and vessel movement) (Ossian OWF: Transmission Infrastructure, 2025).

- 10.12.163 For the CNSE Project noise-related impacts associated with installation noise, which includes vessels was scoped out within the EIA scoping report as it was concluded that any noise would be comparable to general shipping noise and therefore cause no risk of auditory injury and any disturbance would be short-term and only impact a small amount of individuals (CNSE Project, 2023). Therefore, the CNSE Project is not considered further in the assessment of Tier 3 projects for this impact.
- 10.12.164 Based upon the Tier 2 assessment presented in Paragraphs 10.12.137 *et seq.*, disturbance could occur over ranges in the hundreds of metres to several kilometres from subsea noise associated with vessels and other activities at the Tier 3 projects. Given that the Morven South OWF Array and Ossian Transmission Infrastructure are both over 10 km away from the Array Area and Export Cable Corridor, it is unlikely that disturbance ranges will overlap. However, the Morven North OWF and Morven Hawthorn Pit Grid Connection Project are at 10 km and <2 km away, respectively and therefore there might be the potential for overlap of larger disturbance ranges (Table 10.66).
- 10.12.165 Like the Proposed Development and the Tier 2 projects, the Tier 3 projects are likely to commit to Embedded Mitigation of the development of and adherence to an Outline NSVMP (Section 10.9).
- 10.12.166 Vessel noise and other noise producing activities for Tier 3 projects is therefore not likely to affect the conclusions for the assessment for the construction and O&M phase above. The magnitude, sensitivity and significance conclusions remain the same as detailed in in Paragraphs 10.12.153 *et seq.*

INJURY AND DISTURBANCE FROM SUBSEA NOISE GENERATED BY WIND TURBINE OPERATION

Tier 2

O&M Phase

Magnitude of Impact

- 10.12.167 As detailed in Table 10.66, there was two Tier 2 projects identified with the potential for cumulative impact associated with operational Wind Turbine noise in the O&M phase of the Proposed Development:
- Ossian OWF (in the O&M phase); and
 - Berwick Bank OWF (in the O&M phase).
- 10.12.168 The Berwick Bank OWF EIA presented a literature review for the assessment of underwater noise however, the assessment of disturbance to marine mammals from operational noise, which includes operational Wind Turbine noise, was scoped out of the assessment for marine mammals. This potential impact was considered as small with behavioural responses only at close ranges to the Wind Turbines, with previous studies cited to support that operational wind farm noise will have negligible effects and a negligible range on marine mammal

receptors (SSE Renewables, 2022). Therefore, this project is not considered further in the Tier 2 assessment.

- 10.12.169 The Ossian OWF presented a literature review for the assessment of subsea noise generated by the operation of various floating Wind Turbine design options and ‘snapping’ noise from mooring lines (Ossian OWFL, 2024). This impact was considered to be localised to the immediate vicinity of the Ossian OWF with high reversibility and unlikely to lead to the exclusion of marine mammals from this area, and therefore, at most, potentially affect a small proportion of species populations but not alter population trajectories (Ossian OWFL, 2024).
- 10.12.170 Both the Proposed Development alone assessment (see Paragraphs 10.10.285 *et seq.*) and the Ossian OWF drew upon a study completed at the Hywind Floating OWF by Burns *et al.* (2022). This study concluded that noise levels did not breach auditory injury thresholds. The following ranges represented the maximum distances at which TTS onset could occur due to subsea noise from operational Wind Turbines across all marine mammal hearing groups:
- 50 m for harbour porpoise and other VHF cetaceans;
 - 40 m for LF cetaceans (e.g. minke whale and humpback whale);
 - 20 m for phocid pinnipeds (e.g. grey seal and harbour seal); and
 - 10 m for HF cetaceans (e.g. bottlenose dolphin, Risso’s dolphin, and white-beaked dolphin) (Burns *et al.*, 2022).
- 10.12.171 These results assumed that the animal would remain stationary for the 24 hour period and a wind speed of 15 knots (Burns *et al.*, 2022). Even at a wind speed of 25 kts, the subsea noise footprint was considered to be negligible (Burns *et al.*, 2022).
- 10.12.172 As noted for the Proposed Development alone assessment (Paragraphs 10.10.285 *et seq.*) it is considered that operational noise may be audible to marine mammals, but not at levels that would result in a negative behavioural impact.
- 10.12.173 Considering that the Ossian OWF is a minimum of 25.36 km and Berwick Bank is a minimum of 46.53 km from the Array Area (wherein this impact will be located), it is unlikely that there will be any overlap in disturbance ranges associated with subsea noise from operational Wind Turbines (and mooring lines of Ossian OWF) (Table 10.66).
- 10.12.174 The impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. Auditory injury and behavioural disturbance leading to population-level effects are highly unlikely to occur. The magnitude for both auditory injury and behavioural impact is therefore considered to be negligible.

Sensitivity of Receptor

10.12.175 The sensitivity of the receptor is as defined in Paragraphs 10.10.292 *et seq.* above for the Project alone assessment.

Auditory Injury

10.12.176 Marine mammals are deemed to be of medium adaptability (limited ability to avoid or adapt), medium resilience (limited tolerance), low recoverability and high international value. The sensitivity of the receptor is therefore, considered to be medium.

Behavioural Disturbance

10.12.177 Marine mammals are therefore deemed to have the ability to avoid or adapt their behaviour, have some tolerance, with the ability to recover from any impact. The sensitivity of the receptor is therefore, considered to be low.

Significance of Effect

Auditory Injury

10.12.178 Overall, for all marine mammal receptors, the cumulative magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be medium. The cumulative effect will therefore be of Negligible or Minor significance. As a precautionary approach, the significance conclusion is Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Behavioural Disturbance

10.12.179 Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be low. The cumulative effect will therefore be of Negligible or Minor significance. As a precautionary approach, the significance conclusion is **Minor** adverse, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.12.180 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Tier 3

O&M Phase

Magnitude of Impact

10.12.181 In addition to the Tier 2 project, there were two Tier 3 projects identified with the potential for cumulative impact associated with operational Wind Turbine noise in the O&M phase of the Proposed Development:

- Morven North OWF Array (in the O&M phase);
- Morven South OWF Array (in the O&M phase) (Table 10.66).

10.12.182 As Tier 3 projects, there were no specific parameters publicly available, however the Scoping Reports for both projects have the impact of operation noise from Wind Turbines scoped in for further assessment (Orbital Marine Power, 2023; Stromar Offshore Wind Farm, 2024).

- 10.12.183 Morven North OWF Array is 10.03 km and Morven South OWF Array is 43.61 km from the Proposed Development Array Area and is considered to present a similar risk of auditory injury and disturbance as the Proposed Development (i.e. no risk of auditory injury, and limited range of behavioural responses).
- 10.12.184 The assessment of Tier 3 projects is therefore not likely to affect the conclusions for the assessment of Tier 2 projects above. The magnitude, sensitivity and significance conclusions remain the same as detailed in Paragraphs 10.12.178 *et seq.*

INJURY TO MARINE MAMMALS DUE TO COLLISION WITH VESSELS

Tier 2

All Phases

Magnitude of Impact

- 10.12.185 As detailed in Table 10.66, there were six Tier 2 projects identified with the potential for cumulative impact associated with vessel collisions across all phases of the Proposed Development:
- Ossian OWF (in all phases);
 - Berwick Bank OWF (in all phases);
 - Seagreen Phase 1A OFTO (O&M and decommissioning phases);
 - Inch Cape OFTO (O&M and decommissioning phases);
 - Berwick Bank OFTO (Cambois Connection) (O&M and decommissioning phases); and
 - Eastern Green Link 2 (O&M and decommissioning phases).
- 10.12.186 All three phases of the Ossian OWF may overlap with those of the Proposed Development (Table 10.66). The MDS for each phase of the Ossian OWF with respect to vessel collisions is as follows:
- Construction: maximum of 97 vessels on site at once, including site preparation, floating Wind Turbine installation, OSPs installation and IACs and interconnectors. There would be a maximum of 7,902 return trips.
 - O&M: maximum of 31 vessels on sites at once (including CTVs and service operation vessels) for planned activities over the 35-year lifetime of the Ossian OWF.
 - Decommissioning: equal to or less than that of the construction phase (Ossian OWFL, 2024).
- 10.12.187 Therefore, up to 97 vessels may be on site at any one time in the construction and decommissioning phases, with this reducing to up to 31 during the O&M phase. These vessels will be either small in size and able to manoeuvre well to avoid marine mammals or will be large and stationary or slow moving during construction, O&M and decommissioning activities allowing more time to react when a marine mammal is detected (SSE Renewables, 2022). Therefore, the actual increase in vessel traffic moving around the Ossian OWF and to and from ports will occur over short periods in each phase.

- 10.12.188 All three phases of the Berwick Bank OWF may overlap with those of the Proposed Development (Table 10.66). The MDS for each phase of the Berwick Bank OWF with respect to vessel collisions is as follows:
- Construction: maximum of 146 vessels on site at once, including site preparation, Wind Turbine installation, OSPs installation and IACs and interconnectors. There would be a maximum of 11,384 return trips.
 - O&M: maximum of 12 vessels on sites at once (including CTVs and service operation vessels) for planned activities over the 35-year lifetime of the Berwick Bank OWF. There would be a maximum of 875 return trips.
 - Decommissioning: equal to or less than that of the construction phase (SSE Renewables, 2022).
- 10.12.189 Therefore, up to 146 vessels may be on site at any one time in the construction and decommissioning phases, with this reducing down to 12 vessels during the O&M phase. These vessels will be either small in size and able to manoeuvre well to avoid marine mammals or will be large and stationary or slow moving during construction, O&M and decommissioning activities allowing more time to react when a marine mammal is detected (SSE Renewables, 2022). Therefore, the actual increase in vessel traffic moving around the Berwick Bank OWF and to and from ports will occur over short periods in each phase.
- 10.12.190 For the Seagreen Phase 1A OFTO the impact of collision risk due to increased vessel movement for marine mammal receptors was briefly discussed, however it was concluded that due to the highly mobile nature of marine mammals, the slow movement of vessels as well as a non-substantive change to vessel activity in the area collisions are not expected and no significant risks to marine mammal are expected and therefore the Inch Cape OFTO did not assess the impact further.
- 10.12.191 For the Inch Cape OFTO the impact of collision risk due to increased vessel movement for marine mammal receptors was scoped out as agreed by MS-LOT (Inch Cape Offshore Wind Limited, 2018) in the Scoping Opinion for Inch Cape OFTO during all phases as it was determined that the impact was unlikely to lead to significant effects.
- 10.12.192 This was also the case for the Berwick Bank OFTO or Berwick Bank Cambois Connection for the impact of risk of injury resulting from collision of marine mammals with construction and decommissioning vessels was also scoped out of assessment, with agreement with stakeholders and MD-LOT and the MMO following the Scoping Opinion in 2023 (SSE Renewables, 2023). Therefore, Inch Cape OFTO and the Berwick Bank Cambois Connection are considered no further in the assessment of Tier 2 projects for this impact.
- 10.12.193 Lastly, for Eastern Green Link 2 the impact of vessel presence and marine mammal collision risk was assessed during the construction phase only for an environmental appraisal report and as such there was less available information on the numbers of vessels which will be associated with the project during all phases. However, the following types of vessels are listed; survey vessels, cable laying vessels, guard vessels, rock placement vessel, and specialised support

vessels such as a jack-up barge and dive support vessels. Some of these vessels when in operation are expected to reach no higher than 14 knots and when undertaking tasks such as the cable laying the speeds are expected to be as little as four to six kts (The Scottish Government, 2022). As mentioned previously this should allow vessels to manoeuvre well to avoid marine mammals.

- 10.12.194 Although vessels will be moving across a large area (between ports and the Proposed Development and the Tier 2 projects), vessel movements will likely follow existing shipping routes to and from ports. Therefore, the risk of collision to marine mammals is expected to be localised to within the vicinity of the moving vessels. In addition, as detailed in Section 10.10, Embedded Mitigation for the Proposed Development includes the development of and adherence to an Outline NSVMP (Volume 4, Appendix 29: Outline Navigational Safety and Vessel Management Plan), which will include requirements to not deliberately approach marine mammals, avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride, and to remain at safe speeds at all times and reduce speed when a marine mammal is in the vicinity. The Ossian OWF and Berwick Bank OWF also has the adoption of a VMP as Embedded Mitigation (SSE Renewables, 2022; Ossian OWFL, 2024) and the Eastern Green Link 2 also incorporated Embedded Mitigation on vessel requirements and the following of the SMWWC (The Scottish Government, 2022). Overall, even with a cumulative increase in vessel traffic associated, the type of vessels involved, and transit routes is unlikely to impose a much greater risk to marine mammals than baseline levels.
- 10.12.195 The cumulative impact is predicted to be of local spatial extent, long-term duration (over all phases combined), intermittent and whilst the risk will only occur during vessel movements, the effect of collision on marine mammals is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of Receptor

- 10.12.196 The sensitivity of the receptor is as defined in Paragraphs 10.10.314 *et seq.* above for the Project alone assessment.
- 10.12.197 All marine mammals are deemed to have medium vulnerability (on the basis that marine mammals can display avoidance behaviour), medium recoverability (on the basis that not all collisions are fatal). The sensitivity of the receptor is therefore considered to be medium.

Significance of Effect

- 10.12.198 Overall, for all marine mammal receptors, the cumulative magnitude of the impact is deemed to be low, and the sensitivity of the receptor is considered to be medium. The cumulative effect will therefore be of Negligible to Minor significance, the conclusion is **Minor** adverse significance on a precautionary basis significance, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.12.199 No Additional Mitigation is considered necessary, because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

Tier 3

All Phases

10.12.200 As detailed in Table 10.66, alongside the Tier 2 projects, there were five Tier 3 projects identified with the potential for cumulative impact associated with vessel collisions during all phases of the Proposed Development:

- Morven North OWF Array (all phases);
- Morven South OWF Array (all phases);
- Morven Hawthorn Pit Grid Connection Project (construction and O&M phases);
- Ossian Transmission Infrastructure (construction and O&M phases); and
- CNSE Project (O&M phases).

10.12.201 As detailed in Table 10.66, it is possible that the construction, O&M, and decommissioning phases of the Tier 3 projects may overlap with those of the Proposed Development (and the Tier 2 projects). Given that these are Tier 3 projects, with no information on their construction and decommissioning programmes and operational lifetimes in the public domain, all three phases have been combined here for brevity.

10.12.202 Although there is no publicly available information on the numbers and types of vessels which will be associated with the Tier 3 projects, they are likely to be similar to those identified for the Proposed Development alone (Table 10.19) and in the Tier 2 assessment (Paragraph 10.12.185) given the similar scale and nature of the Tier 3 projects. In addition, it is likely that the Tier 3 projects will commit to Embedded Mitigation of a VMP (if this impact is scoped back in for assessment), like the Proposed Development and the Tier 2 projects, which will further reduce the potential for cumulative collision risk.

10.12.203 In addition, the Proposed Development and the Tier 2 and Tier 3 projects are located in an area of relatively high vessel traffic, and therefore it can be expected that marine mammals present in the area will demonstrate some degree of habituation to vessel presence.

10.12.204 Assessment of Tier 3 projects (all phases) is not likely to affect the conclusions for the assessment of Tier 2 projects above. The magnitude, sensitivity and significance conclusions remain the same as detailed in Paragraph 10.12.198.

EFFECTS ON MARINE MAMMALS DUE TO ALTERED PREY AVAILABILITY

Tier 2

Construction Phase

Magnitude of Impact

- 10.12.205 The construction of the Proposed Development alongside other projects may lead to changes in the available prey resources for marine mammals if there are cumulative impacts upon the fish and shellfish community. Potential cumulative impacts on fish and shellfish species during the construction phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology using the appropriate MDSs for these receptors and have been used to inform this assessment for marine mammals. The following impacts upon fish and shellfish ecology were assessed cumulatively in the construction phase of the Proposed Development:
- temporary habitat loss and/or disturbance;
 - long-term habitat loss and/or disturbance (combined with the O&M phase);
 - introduction of artificial habitat and subsequent colonisation of hard structures (combined with the O&M phase);
 - increased SSCs and associated deposition; and
 - subsea noise impacting fish and shellfish receptors.
- 10.12.206 No significant cumulative effects were predicted to occur in the construction phase of the Proposed Development for fish and shellfish ecology, except for the impact; subsea noise impacting fish and shellfish receptors for herring IEF only which was concluded with moderate adverse significance (Volume 2, Chapter 9: Fish and Shellfish Ecology). For subsea noise impacting fish and shellfish receptors three Tier 2 projects were identified with potential for CEA effects during construction, Berwick Bank OWF, Ossian OWF and Salamander OWF. A moderate adverse significance was concluded for the herring IEF due to piling in the construction phase, however, appropriate Embedded Measures and Mitigation will be discussed and agreed with stakeholders to reduce the significance of the cumulative impact of subsea piling noise on herring to minor adverse, which is not significant in EIA terms.
- 10.12.207 With respect to indirect effects on marine mammals, no additional cumulative effects due to changes in prey availability are therefore predicted. As highlighted in Paragraph 10.10.356 *et seq.* all marine mammals considered in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. Given that marine mammals are wide-ranging in nature with the ability to exploit numerous food sources, there would be a variety of prey species available for marine mammal foraging.
- 10.12.208 Therefore, the cumulative impact on marine mammals is predicted to be of a highly localised spatial extent, and the effect is anticipated to be temporary. The magnitude of impact is therefore considered to be low.

Sensitivity of Receptor

- 10.12.209 The sensitivity of the marine mammal receptor is as defined in Paragraphs 10.10.344 *et seq.* above for the alone assessment.
- 10.12.210 All marine mammal receptors are deemed to be of high resilience and adaptability, high recoverability and high international value. The sensitivity of the marine mammal receptor is therefore considered to be low.

Significance of Effect

- 10.12.211 Overall, for all marine mammal receptors, the cumulative magnitude of the impact is deemed to be low, and the sensitivity of the marine mammal receptor is considered to be low. Although the significance conclusion is Negligible or Minor the cumulative effect is concluded to be of **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

- 10.12.212 No Additional Mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

O&M Phase

Magnitude of Impact

- 10.12.213 O&M impacts associated with the Proposed Development alongside other projects which overlap with this phase may lead to changes in the available prey resources for marine mammals if there are cumulative impacts upon the fish and shellfish community. Potential cumulative impacts on fish and shellfish species during the O&M phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology using the appropriate MDSs for these receptors and have been used to inform this assessment for marine mammals. The impacts upon fish and shellfish ecology that were assessed cumulatively in the O&M phase are the same as for the construction phase (Paragraph 10.10.206) of the Proposed Development, with the addition of:
- impacts to fish and shellfish due to EMF.
- 10.12.214 No significant cumulative effects were predicted to occur in the O&M phase of the Proposed Development for fish and shellfish ecology (Volume 2, Chapter 9: Fish and Shellfish Ecology). With respect to indirect effects on marine mammals, no additional cumulative effects due to changes in prey availability are therefore predicted. As highlighted in Paragraph 10.10.356 *et seq.* all marine mammals considered in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. Given that marine mammals are wide-ranging in nature with the ability to exploit numerous food sources, there would be a variety of prey species available for marine mammal foraging.
- 10.12.215 The magnitude, sensitivity and significance conclusions remain the same for O&M phase as for construction, as detailed in Paragraph 10.12.211.

Decommissioning Phase

Magnitude of Impact

- 10.12.216 The decommissioning of the Proposed Development alongside other projects may lead to changes in the available prey resources for marine mammals if there are cumulative impacts upon the fish and shellfish community. Potential cumulative impacts on fish and shellfish species during the decommissioning phase have been assessed in Volume 2, Chapter 9: Fish and Shellfish Ecology using the appropriate MDSs for these receptors and have been used to inform this assessment for marine mammals. The impacts upon fish and shellfish ecology assessed cumulatively in the decommissioning phase of the Proposed Development are the same as for the construction phase.
- 10.12.217 No significant cumulative effects were predicted to occur in the decommissioning phase of the Proposed Development for fish and shellfish ecology. With respect to indirect effects on marine mammals, no additional cumulative effects due to changes in prey availability are therefore predicted. As highlighted in Paragraph 10.10.356 *et seq.* all marine mammals considered in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. Given that marine mammals are wide-ranging in nature with the ability to exploit numerous food sources, there would be a variety of prey species available for marine mammal foraging. The magnitude, sensitivity and significance conclusions remain the same for decommissioning phase as for construction and O&M, as detailed in Paragraph 10.12.211.

Tiers 3 and 4

All Phases

Magnitude of Impact

- 10.12.218 The impacts listed in Paragraph 10.12.205 were also assessed alongside the Tier 3 and 4 projects identified in the fish and shellfish ecology CEA (see Volume 2, Chapter 9: Fish and Shellfish Ecology for full detail). As there were no detailed EIA documents or project parameters in the public domain for the Tier 3 and 4 projects, a detailed CEA like that summarised in Paragraph 10.12.211 was not possible for the Tier 3 and 4 assessments, and they have been combined here, for brevity.
- 10.12.219 Overall, there were no significant cumulative impacts upon fish and shellfish IEFs concluded for any of the impacts considered for all phases of the Proposed Development (see Volume 2, Chapter 9: Fish and Shellfish Ecology for full detail). With respect to indirect effects on marine mammals, no additional cumulative effects due to changes in prey availability are therefore predicted. As highlighted in Paragraph 10.10.356 *et seq.* all marine mammals considered in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. Given that marine mammals are wide-ranging in nature with the ability to exploit numerous food sources, there would be a variety of prey species available for marine mammal foraging.

10.12.220 The cumulative impact is predicted to be of local spatial extent, medium-term duration, intermittent and high reversibility. It is predicted that the impact will affect the marine mammal receptor directly. The magnitude of impact is therefore, considered to be low.

Sensitivity of Receptor

10.12.221 The sensitivity of the marine mammal receptor is as defined in Paragraphs 10.10.344 *et seq.* above for the Proposed Development alone assessment.

10.12.222 All marine mammal receptors are deemed to be of high resilience and adaptability, high recoverability and high international value. The sensitivity of the marine mammal receptor is therefore considered to be low.

Significance of Effect

10.12.223 Overall, for all marine mammal receptors, the cumulative magnitude of the impact is deemed to be low, and the sensitivity of the marine mammal receptor is considered to be low. Although the significance conclusion is Negligible or Minor the cumulative effect is concluded to be of **Minor** adverse significance on a precautionary basis, which is not significant in EIA terms.

Additional Mitigation and Residual Effect

10.12.224 No Additional Mitigation is considered necessary because the likely effect in the absence of Additional Mitigation is not significant in EIA terms.

10.13 Proposed Monitoring

10.13.1 No project specific monitoring measures are proposed given that no significant impacts are predicted from the Proposed Development alone or cumulatively with other plans and projects.

10.14 Summary of Impacts, Mitigation, Likely Significant Environmental Effects and Monitoring

10.14.1 Information on marine mammals within the Regional Marine Mammal Study Area was collected through desktop review, site surveys and consultation. This information is summarised in Sections 10.4 and 10.5.

10.14.2 Table 10.80 presents a summary of the potential impacts, Embedded Mitigation and the conclusion of likely significant environmental effects in EIA terms in respect to marine mammals. The impacts assessed include:

- injury and disturbance from subsea noise generated during piling;
- injury and disturbance from subsea noise generated during UXO clearance;
- injury and disturbance from subsea noise generated during site-investigation surveys;
- injury and disturbance from subsea noise generated by vessel use and other noise producing activities;
- injury to marine mammals due to collision with vessels;
- injury and disturbance from subsea noise generated by Wind Turbine operation; and

- effects on marine mammals due to altered prey availability.

10.14.3 Overall, it is concluded that there will no likely significant environmental effects arising from the Proposed Development during the construction, O&M or decommissioning phases.

Table 10.80: Summary of Assessment of Significance

Description of Impact	Embedded Mitigation ID	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
Construction Phase							
Impact 1: Injury from subsea noise generated during piling	3, 6, 37	All species - Negligible	All species - Medium	Minor adverse	None required.	Minor adverse	None proposed.
Impact 1: Disturbance from subsea noise generated during piling	None	White-beaked dolphin, and grey seal - Medium All other species - Low	Harbour porpoise: Medium All other species: Low	Minor adverse	None required.	Minor adverse	None proposed.
Impact 2: Injury from subsea noise generated during UXO clearance	6, 36, 37, 53	Harbour porpoise - Low All other species - Negligible	All species- High	Minor adverse	Low order clearance techniques are the default method for UXO clearance and would not require Additional Mitigation over and above the Embedded Mitigation measures within the Outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol). However, should high order clearance be unavoidable Additional Mitigation may be required dependant on the results of the UXO Risk Assessment. Appropriate mitigation measures will be discussed and agreed with MD-LOT and NatureScot with the detail to be agreed for the finalised MMMP.	Minor adverse	None proposed.

Description of Impact	Embedded Mitigation ID	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
Impact 2: Disturbance from subsea noise generated during UXO clearance	None	All species - Low	All species - Low	Minor adverse	None required.	Minor adverse	None proposed.
Impact 3: Injury and disturbance from subsea noise generated during site-investigation surveys	6, 37	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 4: Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	None	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Medium	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 6: Injury to marine mammals due to collision with vessels	9	All species - Low	All species - Medium	Minor adverse	None required.	Minor adverse	None proposed.
Impact 7: Effects on marine	N/A	All species - Low	All species - Low	Minor adverse	None required.	Minor adverse	None proposed.

Description of Impact	Embedded Mitigation ID	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
mammals due to altered prey availability							
O&M Phase							
Impact 1: Injury and disturbance from subsea noise generated during site-investigation surveys	6, 37	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 2: Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	None	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Medium	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 5: Injury and disturbance from subsea noise generated by Wind Turbine operation	None	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Negligible	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 6: Injury to marine	9	All species - Low	All species - Medium	Minor adverse	None required.	Minor adverse	None proposed.

Description of Impact	Embedded Mitigation ID	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
mammals due to collision with vessels							
Impact 7: Effects on marine mammals due to altered prey availability	None	Low	Low	Minor adverse	None required.	Minor adverse	None proposed.
Decommissioning Phase							
Impact 4: Injury and disturbance from subsea noise generated by vessel use and other noise producing activities	None	<u>Auditory injury</u> Negligible <u>Behavioural disturbance</u> Low	<u>Auditory injury</u> Medium <u>Behavioural disturbance</u> Medium	<u>Auditory injury</u> Minor adverse <u>Behavioural disturbance</u> Minor adverse	None required.	Minor adverse	None proposed.
Impact 6: Injury to marine mammals due to collision with vessels	9	Low	Medium	Minor adverse	None required.	Minor adverse	None proposed.
Impact 7: Effects on marine mammals due to altered prey availability	None	Low	Low	Negligible adverse	None required.	Negligible adverse	None proposed.

Table 10.81: Summary of Cumulative Effects Assessment

Description of Impact	CEA Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
Construction Phase							
Disturbance from subsea noise generated during piling	Tier 2, Tier 3 and Tier 4	Harbour porpoise - High White-beaked dolphin, bottlenose dolphin, Risso's dolphin - Medium Minke whale, fin whale, humpback whale, grey seal, harbour seal- Low	Harbour porpoise - Medium Bottlenose dolphin, white-beaked dolphin, Risso's dolphin, minke whale, grey seal, harbour seal- Low	Moderate adverse: Significant in EIA terms for harbour porpoise. Minor adverse: Not significant for bottlenose dolphin, white-beaked dolphin, Risso's dolphin. Negligible adverse: minke whale, fin whale, humpback whale, grey seal, harbour seal.	For Harbour porpoise: The modelling conducted has shown that the population decline due to the combined impact of the CEA projects is not driven by the Proposed Development. Therefore, no Additional Mitigation is considered necessary. For all other species: None.	Moderate adverse: (Harbour porpoise – significant) Minor adverse: (Others – not significant)	None
Injury and disturbance from subsea noise generated during UXO clearance (High order)	Tier 2 and Tier 3	Auditory injury - bottlenose dolphin, white-beaked dolphin, Risso's dolphin, fin whale, minke whale, humpback whale, harbour	<u>Auditory injury</u> - High <u>Behavioural disturbance</u> – all species - Low	<u>Auditory injury</u> Bottlenose dolphin, white-beaked dolphin, Risso's dolphin, fin whale, minke whale, humpback whale, harbour seal and grey	<u>Auditory Injury</u> For all species except harbour porpoise: None. For harbour porpoise high order detonation may not be fully mitigable	<u>Auditory injury</u> Bottlenose dolphin, white-beaked dolphin, Risso's dolphin, fin whale, minke whale, humpback whale, harbour seal and grey	None

Description of Impact	CEA Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
		seal and grey seal – negligible Harbour porpoise – Low Behavioural disturbance – all species - Low		seal – Minor adverse Harbour porpoise – Moderate adverse <u>Behavioural disturbance</u> – all species - Minor adverse	depending on the size of the UXO. If low order methods employed the significance of effect will be reduced to Minor	seal – Minor adverse Harbour porpoise – Moderate adverse <u>Behavioural disturbance</u> – all species - Minor adverse	
Behavioural disturbance from site-investigation surveys	Tier 2 and Tier 3	All species-Low	All species -Low	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Behavioural disturbance from vessel use and other noise producing activities	Tier 2 and Tier 3	All species-Low	All species - Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Injury due to collision with vessels	Tier 2 and Tier 3	All species-Low	All species - Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Indirect effects due to altered prey availability	Tier 2, Tier 3, and Tier 4	All species-Low	All species - Low	Minor adverse: Not significant	None	Minor adverse: Not significant	None
O&M Phase							
Injury and disturbance from site-	Tier 2 and Tier 3	All species-Low	All species - Low	Minor adverse: Not significant	None.	Minor adverse: Not significant	None

Description of Impact	CEA Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Mitigation	Significance Residual Effect	Proposed Monitoring
investigation surveys							
Behavioural disturbance from vessel use and other noise producing activities	Tier 2 and Tier 3	All species- Low	All species - Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Injury and disturbance from Wind Turbine operation	Tier 2 and Tier 3	All species- Negligible	<u>Auditory injury</u> - Medium <u>Behavioural disturbance</u> - Low	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Injury due to collision with vessels	Tier 2 and Tier 3	All species- Low	All species - Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Indirect effects due to altered prey availability	Tier 2, Tier 3, and Tier 4	All species- Low	All species - Low	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Decommissioning Phase							
Behavioural disturbance from vessel use and other noise producing activities	Tier 2 and Tier 3	All species- Low	All species - Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Injury due to collision with vessels	Tier 2 and Tier 3	All species- Low	All species Medium	Minor adverse: Not significant	None	Minor adverse: Not significant	None
Indirect effects due to altered prey availability	Tier 2, Tier 3, and Tier 4	All species- Low	All species - Low	Minor adverse: Not significant	None	Minor adverse: Not significant	None

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