Environmental Impact Assessment Report
Volume 3, Appendix 33.3: Marine Mammals CEA

MarramWind Offshore Wind Farm

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MarramWind

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1. Impacts Considered in the Cumulative Effects Assessment

1.1.1.1 The impacts described in **Table 1.1** have been selected as those having the potential to result in the greatest cumulative effect on an identified receptor group. The cumulative impacts presented in this Section have been selected on the basis of the information provided in **Volume 1, Chapter 4**: **Project Description**, as well as the information available in **Appendix 33.1: Identification of Offshore 'Other Developments' for Cumulative Effects Assessment** (CEA).

1.1.1.2 The following impacts assessed for the Project alone are not considered in the cumulative assessment due to:

- the highly localised and / or short-term nature of the impacts;
- embedded environmental measures in place for the Project that will also be in place on other projects, therefore reducing their risk of occurring; and / or
- where the potential significance of the impact has been assessed as negligible.

1.1.1.3 From the impacts assessed in **Volume 1, Chapter 11: Marine Mammals**, the impacts excluded from the CEA for the reasons provided in **paragraph 1.1.1.2** are:

- C1: auditory injury from increased underwater noise during pre-construction surveys;
- C2: auditory injury from increased underwater noise during installation of driven piles;
- C3: auditory injury from increased underwater noise during other construction activities;
- C4 / O7 / D5: indirect effects on marine mammals via changes in prey availability;
- C7: disturbance from increased underwater noise during other construction activities;
- C8 / O2 / D3: vessel collisions from increased vessel presence and traffic;
- C9 / O3 / D4: disturbance from increased vessel presence and traffic;
- C10: auditory injury from unexploded ordnance clearance;
- C11: disturbance from unexploded ordnance clearance;
- O4: long term displacement / habitat change / barrier effects due to offshore wind farm structures;
- D1: auditory injury from increased underwater noise; and
- D2: disturbance from increased underwater noise during decommissioning activities.

1.1.1.4 As introduced in Section 33.3 within **Volume 1, Chapter 33: Cumulative Effects Assessment**, all projects considered alongside the Project have been allocated into 'tiers'. These tiers enable allocation of differing weights of potential impact depending on the certainty of effect from activities associated with the project. Paragraph 33.3.2.8 to 33.3.2.13 and Table 33.5 within **Volume 1, Chapter 33: Cumulative Effects Assessment** set out the full definitions of the tiers, but a summary is included here:

- **Tier 1**: high-level of certainty or information available (including under construction or where a planning application has been approved or is awaiting decision; these have been further categorised where 1a includes 'Other developments' in operation (as per guidance from the Marine Directorate - Licensing Operations Team (MD-LOT) see

Table 33.1, SIT ID: 749), 1c includes Permitted applications, whether under the Electricity Act 1989; Marine and Coastal Access Act 2009 (between 12 and 200 nautical miles (nm)) and the Marine (Scotland) Act 2010 (between 0 and 12 nm) and 1d includes Submitted applications, whether under the Electricity Act 1989; Marine and Coastal Access Act 2009 (between 12 and 200 nm) and the Marine (Scotland) Act 2010 (between 0 and 12 nm); Town and Country Planning (Scotland) Act 1997; or other regimes, but not yet determined; Town and Country Planning (Scotland) Act 1997; or other regimes, but not yet implemented);

- **Tier 2**: medium-level of certainty or information (such as developments where a Scoping Report has been submitted); and
- **Tier 3**: low-level of certainty or information available (no planning applications submitted or identified for potential future development only; no Tier 3 Projects are included in this short-list).

Table 1.1 Impacts considered for the CEA on marine mammals

Project stage	Potential impacts	Maximum design scenario	Justification
Construction	C5: disturbance from increased underwater noise during pre-construction surveys.	Tier 1: All tier 1 developments except from those that are / will already be operational (for example, Culzean Offshore Wind Farm, Hywind Offshore Wind Farm, Kincardine Offshore Wind Farm, Green Volt Offshore Wind Farm, Salamander Offshore Wind Farm and Pentland Floating Offshore Wind Farm) by the time the Project enters the construction stage. Tier 2: All developments within Tier 2.	If pre-construction surveys for the 'other developments' occur concurrently with the pre-construction surveys of the Project, there is a risk of a cumulative impact of disturbance. All 'other developments' with a construction stage that overlaps with the construction stage of the Project therefore have the potential to lead to cumulative impacts from disturbance from increased underwater noise during pre-construction surveys. The inclusion of all non-operational Tier 1 and Tier 2 developments ensures a precautionary approach to assessing the cumulative effect.
Construction	C6: disturbance from increased underwater noise during installation of driven piles.	Tier 1: All tier 1 developments except from those that are / will already be operational (for example, Culzean Offshore Wind Farm, Hywind Offshore Wind Farm, Kincardine Offshore Wind Farm, Green Volt Offshore Wind Farm, Salamander Offshore Wind Farm and Pentland Floating Offshore Wind Farm) by the time the Project enters the construction stage. Tier 2: All developments within Tier 2.	If piling for the 'other developments' occur concurrently with the piling of the Project, there is a risk of a cumulative impact of disturbance. All 'other developments' with a construction stage that overlaps with the piling dates for the Project have the potential to lead to cumulative impacts from disturbance from increased underwater noise during installation if the piling dates of the 'other developments' overlap with those of the Project. The inclusion of all non-operational Tier 1 and Tier 2 developments ensures a precautionary approach to assessing the cumulative effect.
Operation and maintenance (O&M)	O1: electromagnetic fields (EMF) from cables.	All Tier 1 and Tier 2 developments as the O&M stage of all other developments is expected to overlap with the O&M stage of the Project.	All 'other developments' with an O&M stage that overlaps with the O&M stage of the Project have the potential to lead to cumulative impacts of EMF from cables. While individual cable EMF may be weak and have a small spatial extent, the cumulative presence of multiple cables across 'other developments' could result in an increase in the spatial extent and intensity of EMF exposure.

Project stage	Potential impacts	Maximum design scenario	Justification
O&M	O5: entanglement in lines and cables for example, mooring lines and array cables.	Tier 1: Floating Tier 1 Offshore Wind Farms: • Cenos; • Culzean; • Green Volt; • Hywind ; • Kincardine; • Muir Mhòr; • Ossian; • Pentland Floating; and • Salamander. Tier 2: Floating Tier 2 Offshore Wind Farms: • Arven; • Aspen; • Ayre; • Bellrock; • Broadshore; • Buchan; • CampionWind; • Scaraben; and • Stromar.	Floating Offshore Wind Farms use extensive mooring systems and dynamic array cables, which pose entanglement risks to marine mammals. All floating offshore wind farms with an O&M stage that overlaps with the O&M stage of the Project therefore have the potential to lead to cumulative impacts from entanglement in lines and cables. Assessing all floating offshore wind farms with overlapping O&M stages ensures that entanglement risk is assessed across the full spatial footprint of potential exposure.
O&M	O6: increased underwater noise for example, operational noise and mooring noise	All listed Tier 1 and Tier 2 Offshore Wind Farm developments are expected to overlap with the O&M stage of the Project.	While individual offshore wind farms may produce low-level noise, the cumulative effect of multiple developments operating simultaneously can elevate ambient noise levels. All offshore wind farms with an O&M stage that overlaps with the O&M stage of the Project therefore have the potential to lead to cumulative impacts from increased underwater noise for example, operational noise and mooring noise.

2. Precaution in the Cumulative Effects Assessment

2.1.1.1 The following assumptions have been made while undertaking this CEA on marine mammal receptors. Most Environmental Impact Assessment (EIA) Reports assess the maximum design scenario of their Project in the effort to gain consent of the scenario with the largest potential impact (spatially and / or temporally); therefore, results included in these assessments are usually over precautionary due to unknown final project design and timelines. Significant levels of precaution / conservatism within CEAs will result in the estimated effects being unrealistic. The areas of precaution / conservatism in the assessment include:

- The assumption that floating offshore wind projects will involve piling for all proposed turbines given a lack of information on anchoring systems that will be used.
- The number of developments assumed to be installing foundation structures at one time is unrealistic given availability of construction vessels worldwide.
- The duration and timelines for other developments are worst-case scenarios and the true period of piling activity will likely be shorter for each project.
- Due to unknown pilling schedules, CEAs often assume that pilling could occur throughout an estimated piling window which often far exceeds the number of days required to install the piles included in the maximum design scenario. This results in estimated impact levels which are far greater than what would occur in reality.
- Where impact ranges are not available for projects included in the CEA, an effective deterrent range (EDR) has been used following Joint Nature Conservation Committee (JNCC) (2020) guidance. The EDRs were developed to determine the average distances over which harbour porpoise would be disturbed / displaced in their special areas of conservation in English, Welsh and Northern Irish marine areas. The EDRs from JNCC (2020) have been applied across all species as a precautionary approach as there is no advice available for other marine mammal species currently and harbour porpoise are deemed of higher sensitivity to underwater noise disturbance.
    - These EDRs have since been updated in the JNCC (2025) guidance; however, these values were not publicly available at the time of writing this assessment which is why the values included in JNCC (2020) have been used. The newer guidance includes the following updated values where the EDR for monopile installation without noise abatement has decreased from 26 kilometres (km; included in this assessment) to 20km, based on evidence from passive acoustic monitoring studies (for example, Brandt *et al*., 2018; Geelhoed *et al*., 2018; Thompson *et al.,* 2025). However, the EDR for pin pile installation without noise abatement has increased in the latest guidance from 15km (included in this assessment) to 20km. Brown *et al.* (2025) note that there remains uncertainty in the evidence of disturbance from pile driving and estimated the impact to be between 15 to 20km. The JNCC (2025) guidance took the higher end of this range as a precautionary measure.
    - These piling EDRs are also considered precautionary due to some studies, such as Graham *et al*. (2019), which have reported a 50% probability of harbour porpoises responding within 7.5km from the location of the first pile driven within installation of offshore wind farm foundations in the Moray Firth, which decreased to 1.3km from the location of the last pile driven. This suggests individuals may, to some degree, habituate to piling activities over time.

  - Five-kilometre EDRs have also been applied to site investigation surveys following the JNCC (2020) guidance. However, these have since been separated by activity within the updated guidance to the following: sub bottom profilers (SBPs; 3km), ultrashort baseline (USBL; 3km), multiple transducer Single Beam Echo Sounders or Multibeam Echo Sounders (MBES) with an operating frequency of ≤12 kilohertz operating in waters ≤200 metres (m) (3km), Seismic surveys of airgun arrays of sizes > 12 and < 3,570 in^3 (10km) and mini-airguns of ≤ 12 in^3 (5km); and
- In the absence of site-specific underwater noise modelling outputs for all the projects included in the cumulative assessment, using the 26km EDR has been identified as the best approach for projects which have not undertaken modelling. However, caution should be applied when making direct comparisons across projects where numbers of disturbed animals have been derived from underwater noise modelling, as these are not directly comparable to the EDR approach.

3. Screening Projects

3.1.1.1 The ‘other developments’ selected as relevant to the assessment of impacts to marine mammals are based upon an initial screening exercise undertaken on a ‘long list’. Each project, plan or activity has been considered and screened in or out based on effect–receptor pathway, data confidence, and the temporal and spatial scales involved.

3.1.1.2 The key stressor to marine mammal receptors from marine developments is underwater noise. Underwater noise modelling is conducted for any marine development with an activity which could lead to significant effects. From a cumulative effects perspective, the main impact of concern is disturbance. For individual developments, the maximum estimated disturbance distances typically fall within the 10s of kilometre ranges. However, it would not be appropriate to use an arbitrary fixed buffer distance as this would not account for the larger scale of movement and population structure of marine mammals.

3.1.1.3 For cetacean species, the zone of influence (ZOI) considers effects over the scale of the three Small Cetacean Abundance in the North Sea (SCANS) IV Blocks (CS-K, NS-E and NS-D) (as defined in Gilles *et al.*, 2023) that overlaps or has connectivity with the Project. These block boundaries are determined based on a biologically appropriate spatial scale for abundance estimates used for assessing the conservation status of cetaceans. The SCANS IV Blocks have been used in place of species-specific cetacean Management Unit (MU; Inter-Agency Marine Mammal Working Group, 2023) boundaries as these can be very large and encompass the whole North Sea or all UK waters and extend to some European country borders. This far exceeds many assigned species population boundaries and the impact ranges of all proposed activities associated with the Project. However, the MUs have been used as the reference populations against which assessments have been presented.

3.1.1.4 For seals, the ZOI considers effects that could arise within the relevant Seal Management Areas (SMAs), as defined by the defined by the Special Committee on Seals (SCOS, 2024), for the respective species.

3.1.1.5 Considering these ZOI and applying criteria set out in paragraph 33.3.3.3 of **Volume 1, Chapter 33: Cumulative Effects Assessment**, the Projects listed within the ‘long list’ (**Appendix 33.1**) which fell under the following categories were screened out of the assessment:

- outwith the ZOI;
- no data available;
- no timeline available;
- no conceptual effect-receptor pathway;
- no physical effect-receptor overlap; and
- no temporal overlap (when considering the potential for phase-specific disturbance from underwater noise).

3.1.1.6 On the basis of the above, the ‘other developments’ that are scoped into the marine mammals CEA are presented in **Table 3.1.** Potential impacts where construction timelines of other projects overlap with the proposed construction dates for the Project will be taken into consideration with respect to cumulative underwater noise (for example, impacts C5 and C6). Floating offshore wind projects that are currently operational are also considered with respect to secondary / indirect entanglement (for example, impact O5) and increased underwater noise (for example, impact O6). Due to the current uncertainty of disturbance from EMF and the number of projects proposed to be constructed across the east coast of

Scotland, this potential impact (for example, impact O1) has also been considered in the CEA. From publicly available information, expected construction timelines were obtained for offshore wind farm projects only. Therefore, these were the only projects considered quantitatively in this CEA.

Table 3.1 'Other developments' to be considered as part of the marine mammal CEA

ID	'Other development' type	Name of 'other development'	Status	Confidence in assessment[1]	Distance to the Project (km)
Offshore wind farms – Tier 1a					
OWF-040	Offshore Wind Farm	Hywind Scotland Pilot Park	Operational	High – project details published in the project domain.	66.8km south west of option agreement area (OAA). The Project's offshore cable route crosses Hywind's offshore cable route.
OWF-045	Offshore Wind Farm	Kincardine – Phase 1 and Phase 2	Operational	High – project details published in the project domain.	126km south west of OAA. 54.5km south of the offshore export cable corridor.
Offshore wind farms – Tier 1c					
OWF-009	Offshore Wind Farm	Berwick Bank Offshore Wind Farm	Consented	High – project details published in the project domain.	174.9km south west of the OAA. 114km southwest of the offshore export cable corridor.
OWF-032	Offshore Wind Farm	Green Volt Offshore Wind Farm (Innovation for Targeted Oil and Gas (INTOG) 6)	Consented	High – project details published in the project domain.	9.2km south of OAA. The Project's offshore cable route crosses Green Volt Offshore Wind Farm's offshore cable route.
OWF-059	Offshore Wind Farm	Salamander Offshore Wind Farm (INTOG 3)	Operational	High – project details published in the project domain.	47.8km south west of OAA. The Project's offshore cable corridor overlaps Salamander Offshore Wind Farm's cable corridor.
OWF-068	Offshore Wind Farm	Culzean Offshore Wind Farm (INTOG 12)	Consented	High – project details published in the project domain.	168.3km south east of OAA. 168.1km south east of the offshore export cable corridor.

[1] Confidence in assessment is structured as follows: **High**: 'Other development' details published in the public domain, **Medium**: Third-party project details published in the public domain but not confirmed as being 'accurate', **Low**: EIA Report not available.

ID	'Other development' type	Name of 'other development'	Status	Confidence in assessment [1]	Distance to the Project (km)
OWF-073	Offshore Wind Farm	Pentland Floating Offshore Wind Farm	Consented	High – project details published in the project domain.	186.9 north west of OAA. 186.7km north west of the offshore export cable corridor.
OWF-134	Offshore Wind Farm	Seagreen 1A Offshore Wind Farm	Consented	High – project details published in the project domain.	171.8km south west of the OAA. 103.7km south west of the offshore export cable corridor.
Offshore wind farms - Tier 1d					
OWF-014	Offshore Wind Farm	Buchan Offshore Wind Floating Energy Allyance NE8 (ScotWind Plan Option Area (PO) NE8)	Application submitted but not yet determined.	High – project details published in the project domain.	22.1km west of OAA. 23.8km south east of the offshore export cable corridor.
OWF-015	Offshore Wind Farm	Caledonia Offshore Wind Farm (PO NE4)	Application submitted but not yet determined.	High – project details published in the project domain.	83.4km west of OAA. 61.9km north west of the offshore export cable corridor.
OWF-017	Offshore Wind Farm	Cenos Offshore Wind Farm (INTOG 11)	Application submitted but not yet determined.	High – project details published in the project domain.	140.8km south east of OAA. Offshore cable route crossed the offshore export cable corridor.
OWF-052	Offshore Wind Farm	Muir Mhòr Offshore Wind Farm (PO E2)	Application submitted but not yet determined.	High – project details published in the project domain.	59km south of OAA. 35.8km south east of the offshore export cable corridor.
OWF-056	Offshore Wind Farm	Ossian Floating Offshore Wind Farm (PO E1)	Application submitted but not yet determined.	High – project details published in the project domain.	126.2km south of OAA. 79.5km south east of the offshore export cable corridor.

ID	'Other development' type	Name of 'other development'	Status	Confidence in assessment [1]	Distance to the Project (km)
OWF-072	Offshore Wind Farm	West of Orkney Offshore Wind Farm (PO N1)	Consented	High – project details published in the project domain.	195.7km north west of the OAA. 181km north west of the offshore export cable corridor.
Offshore wind farms – Tier 2					
OWF-003	Offshore Wind Farm	Aspen Offshore Wind Farm (INTOG 7)	Pre-planning	High – project details published in the project domain.	25 km south east of OAA. 27.3km south east of the offshore export cable corridor.
OWF-008	Offshore Wind Farm	Bellrock Offshore Wind Farm (PO E1)	Pre-planning	High – project details published in the project domain.	122.8km south of OAA. 70.7km south east of the offshore export cable corridor.
OWF-013	Offshore Wind Farm	Broadshore Offshore Wind Farm (PO NE6)	Pre-planning	High – project details published in the project domain.	46.6km west of OAA. 37.8km south east of the offshore export cable corridor.
OWF-016	Offshore Wind Farm	CampionWind Offshore Wind Farm (PO E2)	Pre-planning	High – project details published in the project domain.	62.3km south of OAA. 62.3km south east of the offshore export cable corridor.
OWF-018	Offshore Wind Farm	Bowdun Offshore Wind Farm (PO E3)	Pre-planning	High – project details published in the project domain.	113km south west of OAA. 50.2km south of the offshore export cable corridor.
OWF-019	Offshore Wind Farm	Ayre Offshore Wind Farm (PO NE2 Cluaran Ear-Thuath)	Pre-planning	High – project details published in the project domain.	92.8km north west of OAA. 93.7km south east of the offshore export cable corridor.
OWF-051	Offshore Wind Farm	Morven Offshore Wind Farm (PO E1)	Pre-planning	High – project details published in the project domain.	126.7km south of OAA. 71km south east of the offshore export cable corridor.

ID	'Other development' type	Name of 'other development'	Status	Confidence in assessment [1]	Distance to the Project (km)
OWF-060	Offshore Wind Farm	Scaraben Offshore Wind Farm (INTOG 2)	Pre-planning	High – project details published in the project domain.	42.6km west of OAA. 42.4km west of the offshore export cable corridor.
OWF-066	Offshore Wind Farm	Stromar Offshore Wind Farm (PO NE3)	Pre-planning	High – project details published in the project domain.	73.4km west of OAA. 74.2km west of the offshore export cable corridor.
OWF-074	Offshore Wind Farm	Arven Offshore Wind Farm (PO NE1)	Pre-planning	High – project details published in the project domain.	200.9km north of OAA. 198.4km North of offshore export cable corridor.
Cables and pipelines (CP) - Tier 1d					
CP-003	Cables and pipelines	Spittal to Peterhead Subsea Cable link	Application submitted but not yet determined.	High – project details published in the project domain.	52.9km south west of OAA. Approximately 0.5km North of the offshore export cable corridor.
Cables and pipelines - Tier 2					
CP-002	Cables and pipelines	Eastern Green Link 3	Pre-planning	High – project details published in the project domain.	80.5km south west of OAA. 1.55km south of the offshore export cable corridor.
CP-006	Cables and pipelines	Eastern Green Link 4	Pre-planning	High – project details published in the project domain	223.35km south of OAA. 156.67km south of the offshore export cable corridor.

4. Cumulative Effects Assessment

4.1.1.1 This Section outlines the assessment conducted on the Project cumulatively with 'other developments' included in **Table 3.1**. **Table 4.1** shows the projects included in the marine mammal CEA short list over the construction timeframe of the Project. In total, 24 offshore wind farm projects and four cable and pipeline projects were included in addition to the Project. Due to the unconfirmed construction years included in Project EIAs, and uncertainty of years requiring pile driving, the assessment presents project timescales a year either side of the proposed construction period for the Project (inclusive of pre-construction, offshore substation and reactive compensation platform foundation installation and floating wind turbine generator (WTG) attachment) as a precautionary measure.

4.1.1.2 The methodology for the CEA follows the method as set out in the Project alone assessment within Section 11.8 of **Volume 1, Chapter 11: Marine Mammals** regarding significance evaluation of receptor sensitivity, magnitude of impact and overall significance of effect.

Table 4.1 Marine mammal CEA short list, red boxes indicate years where pile driving activities are expected to occur for the Project

Project	Type[2]	EIA Report[3]	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	HP (NS) MU	BND (CES) MU	BND (GNS) MU	CGNS MU	GS SMA	HS SMA
Marram	FOWF	Y					P			P		P	P				Y	N	Y	Y	Y	Y
Arven*	FOWF	N															Y	N	Y	Y	N	N
Aspen	FOWF	Y	P	P													Y	Y	Y	Y	Y	Y
Ayre*	FOWF	N															Y	Y	Y	Y	Y	Y
Bellrock*	FOWF	N															Y	N	Y	Y	Y	Y
Berwick Bank**	OWF	Y															Y	N	Y	Y	Y	Y

[2] OWF = fixed foundation offshore wind farm, FOWF = floating offshore wind farm, CP = cables and pipelines
[3] EIA Report Y / N denotes whether a quantitative impact assessment for piling is available

Project	Type[2]	EIA Report[3]	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	HP (NS) MU	BND (CES) MU	BND (GNS) MU	CGNS MU	GS SMA	HS SMA
Bowdun**	OWF	N															Y	N	Y	Y	Y	Y
Broadshore*	FOWF	N															Y	N	Y	Y	N	N
Buchan**	FOWF	N															Y	N	Y	Y	Y	Y
Caledonia	OWF	Y															Y	Y	Y	Y	N	N
CampionWind*	FOWF	N															Y	N	Y	Y	Y	Y
Cenos*	FOWF	Y															Y	N	Y	Y	Y	Y
Culzean	FOWF	Y															Y	N	Y	Y	Y	Y
Green Volt	FOWF	Y															Y	N	Y	Y	Y	Y

Project	Type[2]	EIA Report[3]	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	HP (NS) MU	BND (CES) MU	BND (GNS) MU	CGNS MU	GS SMA	HS SMA
Hywind	FOWF	Y															Y	Y	Y	Y	Y	Y
Kincardine	FOWF	Y															Y	Y	N	Y	Y	Y
Morven*	OWF	N															Y	N	Y	Y	Y	Y
Muir Mhòr	FOWF	Y	**P**	**P**	**P**												Y	Y	Y	Y	Y	Y
Ossian*	FOWF	Y															Y	Y	Y	Y	Y	Y
Pentland Floating	FOWF	Y															Y	Y	N	Y	Y	Y
Salamander	FOWF	Y															Y	N	Y	Y	Y	Y
Scaraben*	FOWF	N															Y	N	Y	Y	Y	Y

Project	Type[2]	EIA Report[3]	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	HP (NS) MU	BND (CES) MU	BND (GNS) MU	CGNS MU	GS SMA	HS SMA
Seagreen 1A*	OWF	Y															Y	Y	Y	Y	Y	Y
Stromar*	FOWF	N															Y	N	Y	Y	Y	Y
West of Orkney	Fixed	Y	**P**	**P**													Y	N	Y	Y	Y	Y
Spittal to Peterhead Subsea Cable link	CP	Y															Y	Y	Y	Y	Y	Y
Eastern Green Link 3	CP	N															Y	Y	Y	Y	Y	Y
Eastern Green Link 4	CP	N																				

Project	Type[2]	EIA Report[3]	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	HP (NS) MU	BND (CES) MU	BND (GNS) MU	CGNS MU	GS SMA	HS SMA
Orange cells denote years in which construction is expected / could occur, orange cells with a ‘P’ denote years in which piling activities are expected / could occur, green cells denote years in which projects are operational. Projects screened into / out of species-specific assessments are denoted by Y / N for HP (harbour porpoise) NS (North Sea) MU, BND (bottlenose dolphin) CES (Coastal East Scotland) or GNS (Greater North Sea) MUs, CGNS (Celtic and Greater North Seas) MU (white-beaked dolphin, common dolphin, Risso’s dolphin, white-sided dolphin and minke whale), GS SMA (grey seal; including East Scotland and North Coast and Orkney SMAs) and HS SMA (harbour seal; including East Scotland and North Coast and Orkney SMAs). ‘*’ denote projects without information on piling years. ‘+’ denote projects with discrepancies within publicly available information (*for example,* construction information differs between EIA Report project description and marine mammal chapters).																						

4.2 Construction effects

4.2.1 Impact C5: disturbance from increased underwater noise during pre-construction surveys

Sensitivity of receptor

4.2.1.1 During the Project alone assessment, all marine mammal receptors were assessed as having a low sensitivity to disturbance from underwater noise during pre-construction surveys (see Section 11.9.6 in **Volume 1, Chapter 11: Marine Mammals**). Therefore, for the purpose of the CEA, the sensitivity of all marine mammal receptors to disturbance from underwater noise during pre-construction surveys is **low**.

Magnitude of cumulative impact

4.2.1.2 All projects included within the CEA will carry out pre-construction geophysical surveys during the construction stage; however, the number and timing of surveys that could be undertaken are unknown.

4.2.1.3 As discussed in Section 11.9.6 in **Volume 1, Chapter 11: Marine Mammals**, MBES and Side Scan Sonar (SSS) used in shallow waters of the North Sea (where the Project and all ‘other developments’ are located) operate at high frequencies that fall outside the hearing range of marine mammals (JNCC, 2017). Consequently, the magnitude of disturbance from increased underwater noise during MBES and SSS surveys is considered **negligible**. Since these frequencies are beyond the auditory capabilities of marine mammals, it follows that they are unlikely to perceive or be physiologically affected by the sound.

4.2.1.4 USBLs have been found to cause behavioural disturbance in marine mammals, but only within a limited spatial range, typically a few hundred metres (Pace *et al.,* 2021). Similarly, the lower frequencies used by SBPs and Ultra-High Resolution Seismic sparkers may cause short-term behavioural responses such as avoidance. However, these impacts are localised, with BEIS (2020) estimating a maximum disturbance range of 2.5km for harbour porpoises from SBPs, with an overall low risk of behavioural impact.

4.2.1.5 JNCC’s 2020 guidance for assessing disturbance in harbour porpoise SACs recommends a 5km EDR for other (non-airgun) geophysical surveys (JNCC, 2020). This 5km EDR has therefore been applied to the assessment of disturbance of harbour porpoise from pre-construction surveys, and in the absence of equivalent guidance for other species, is also applied to other marine mammal species. A recent update to this guidance (JNCC, 2025) has reduced this EDR to 3km for USBLs and SBPs which means that this assessment has included a conservative estimate of disturbance ranges.

4.2.1.6 The spatial extent of potential disturbance from pre-construction surveys is limited to a few kilometres around the source, and the surveys themselves are of short duration. As a result, both the spatial and temporal overlap between the Project and the other developments is minimal. As such, the magnitude of the cumulative effect has been assessed as **low**.

Significance of cumulative effect

4.2.1.7 A summary of the cumulative impact magnitude, receptor sensitivity and significance of cumulative effect for marine mammal receptors are presented in **Table 4.2.**

4.2.1.8 The magnitude of the cumulative impact of disturbance from increased underwater noise during pre-construction surveys is deemed to be **low,** with the sensitivity of all receptors being **low**. The cumulative effect of disturbance from increased underwater noise during pre-construction surveys will, therefore, be of **Negligible** (**Not Significant**) in EIA terms.

Table 4.2 Significance of impact C5: disturbance from increased underwater noise during pre-construction surveys

Receptor	Magnitude	Sensitivity	Significance
Harbour porpoise	**Low**	**Low**	**Negligible** (**Not Significant**).
Bottlenose dolphin	**Low**	**Low**	**Negligible** (**Not Significant**).
Risso's dolphin	**Low**	**Low**	**Negligible** (**Not Significant**).
Atlantic white-sided dolphin	**Low**	**Low**	**Negligible** (**Not Significant**).
White-beaked dolphin	**Low**	**Low**	**Negligible** (**Not Significant**).
Short-beaked common dolphin	**Low**	**Low**	**Negligible** (**Not Significant**).
Minke whale	**Low**	**Low**	**Negligible** (**Not Significant**).
Humpback whale	**Low**	**Low**	**Negligible** (**Not Significant**).
Harbour seal	**Low**	**Low**	**Negligible** (**Not Significant**).
Grey seal	**Low**	**Low**	**Negligible** (**Not Significant**).

4.2.2 Impact C6: disturbance from increased underwater noise during installation of driven piles

4.2.2.1 This Section has been informed by the most up to date information publicly available at the time of writing this report. Some discrepancies are found within some projects scoped into the assessment and interim population consequences of disturbance (iPCoD) modelling results presented in this Section. These discrepancies are due to some projects having released EIA Reports within six months of this assessment's submission for consent and being released after the iPCoD modelling was completed. Where EIA Report values were not available at the time of running the iPCoD model, EDR calculations were used which can differ from dose-response values. EIA Report values have been included here for completeness and justifications are included where numbers of individuals impacted differ.

Sensitivity of receptor

4.2.2.2 During the Project alone assessment, all marine mammal receptors were assessed as having a low sensitivity to disturbance from underwater noise during installation of driven piles (see Section 11.9.7 in **Volume 1, Chapter 11: Marine Mammals**). Therefore, for the purpose of the CEA, the sensitivity of all marine mammal receptors to disturbance from underwater noise during installation of driven piles is **low**.

Magnitude of cumulative impact

4.2.2.3 While the construction window for the Project spans up to 12 years from 2030, the maximum design scenario assumes up to 1,856 piling days in total, which is substantially less than continuous activity across the full window. Piling will occur in discrete campaigns with breaks between operations, meaning that disturbance will be intermittent and temporary rather than sustained over the entire period. Piling years for the Project are expected to occur in 2033 (Phase 1), 2036 (Phase 2), 2038 and 2039 (Phase 3). These years have been included in the iPCoD model (**Appendix 11.2: Population Distribution Modelling**) and within this assessment.

4.2.2.4 In the absence of detailed, final construction schedules for all projects, a worst-case temporal overlap is assumed for years where multiple projects indicate piling activity. Estimates represent instantaneous (per piling day) disturbance, meaning they do not imply continuous displacement throughout a year. This assessment presents the maximum daily number of individuals predicted to be disturbed in each year. Total disturbance numbers are shown for the other developments as highlighted in **Table 4.1** grouped into their relevant tiers (Tiers 1c, 1d and 2).

4.2.2.5 For all other developments, species-specific densities within the corresponding SCANS-IV (Gilles *et al.,* 2023) survey blocks, or SCANS-III (Hammond *et al*., 2021) when SCANS-IV block densities were not available, for each cetacean species have been used for calculation of the maximum indicative number of animals disturbed per day. The only exception is the bottlenose dolphin assessment for the CES MU, which used densities based on Cheney *et al*. (2024). For seal species, the indicative numbers of seals disturbed per day have been calculated from at-sea densities derived from Carter *et al*. (2022; 2025).

4.2.2.6 Project-specific disturbance ranges have been defined using the project-specific underwater noise modelling for projects with a quantitative assessment or using a fixed EDR approach for projects without a publicly available quantitative assessment. In addition, if a project excluded a species from assessment in their EIA Report, that species was not considered in this CEA for that project. It is noted that different quantitative impact assessments used different methods to assess disturbance from pile driving activities. Some used a dose-response function, while others used an EDR approach, or used temporary threshold shift as a proxy for disturbance. Therefore, the number of animals predicted to be disturbed by each project is not directly comparable. However, consent is granted to projects based on the values presented in their EIA Report and thus these values are considered the most suitable to take forward in this quantitative CEA, despite the different methods used across projects. It is important to note that this approach is highly precautionary given the high level of uncertainty and assumptions within this assessment, as described in further detail below.

4.2.2.7 The EDR threshold parameters used to assess the number of animals potentially disturbed from offshore projects are:

- a 26km EDR for piling of fixed offshore wind farm projects based on guidance from JNCC (2020) for unabated pile driving of a monopile, leading to an impact area of 2,123.72 km^2;
- a 15km EDR for piling of floating offshore wind farm projects based on guidance from JNCC (2020) for unabated pile driving of pin piles, leading to an impact area of 706.9 km^2; and
- a 5km EDR for subsea cabling based on guidance from JNCC (2020; assuming that only geophysical surveys will be undertaken), leading to an impact area of 78.5 km^2.

4.2.2.8 Cumulative iPCoD modelling has also been included in the CEA as modelled for the Project alone to compare the projected baseline population with the potential future impacted population taking the cumulative effects of disturbance from increased underwater noise during installation at multiple offshore wind farms into consideration.

Harbour porpoise

4.2.2.9 The highest number of harbour porpoises predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.3**). The maximum cumulative number of harbour porpoise predicted to be disturbed during the pile driving campaign of the Project is 35,673 individuals (10.29% of the MU population) in 2033. The number of harbour porpoise predicted to be impacted by the Project represents 41.45% of this total (for instance, 41.45% of 10.29% of the MU population).

4.2.2.10 The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **medium** for harbour porpoises.

Table 4.3 Number of harbour porpoise predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Marram	1	EIA Report Dose-response					14,787			14,787		14,787	14,787			
Arven	2	EDR (15km)		365	365	365	365									
Aspen	2	EIA Report Dose-response	10,652	10,652												
Ayre	2	EDR (15km)	199	199	199	199	199									
Bellrock	2	EDR (15km)	424	424												
Berwick Bank	1	EIA Report Dose-response	1,754	1,754	1,754	1,754	1,754									
Bowdun	2	EDR (26km)	1,271	1,271	1,271	1,271	1,271									
Broadshore	2	EDR (15km)	199													
Buchan	2	EDR (15km)		365	365	365	365	365								
Caledonia	1	EIA Report Dose-response	8,201	8,201	8,201	8,201										
CampionWind	2	EDR (15km)	424	424												
Cenos	1	EIA Report Dose-response		9,529	9,529	9,529	9,529	9,529	9,529							
Eastern Green Link 3	2	EDR (5km)	47	47	47	47	47									
Eastern Green Link 4	2	EDR (5km)	47	47	47	47	47									
Morven	2	EDR (26km)	1,271													
Muir Mhòr	1	EIA Report Dose-response	15,245	15,245	15,245											
Ossian	1	EIA Report Dose-response			7,309	7,309	7,309	7,309	7,309	7,309	7,309	7,309				
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	365	365												

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Seagreen 1A	1	EIA Report Dose-response	1,882	1,882	1,882	1,882										
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	47	47												
Stromar	2	EDR (15km)	199	199												
West of Orkney	1	EIA Report Dose-response	1349	1349												
Total	1, 2	#	43,576	52,365	46,214	30,969	35,673	17,203	16,838	22,096	7,309	22,096	14,787	0	0	0
		% of MU	12.57	15.11	13.33	8.94	10.29	4.96	4.86	6.38	2.11	6.38	4.27	0.00	0.00	0.00

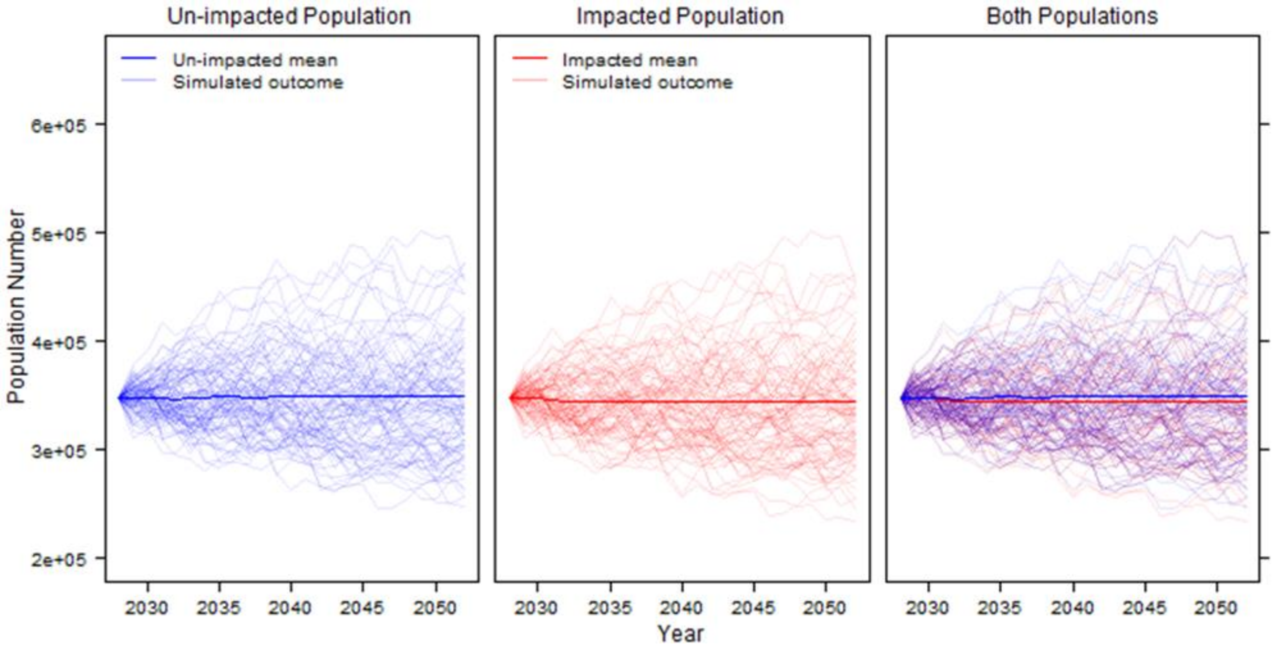
4.2.2.11 To determine whether cumulative disturbance is expected to result in population level impacts, iPCoD modelling was conducted (noting Cables and Pipeline projects for excluded from the modelling). For the cumulative scenario, the disturbance numbers for harbour porpoise used in the modelling are presented in **Table 4.4**.

Table 4.4 Number of harbour porpoise in the NS MU disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day
Marram	2033	2039	14,787
Arven offshore substations	2030	2033	365
Arven WTG	2030	2033	365
Ayre offshore substations	2030	2033	199
Ayre WTG	2030	2033	199
Bowdun	2029	2032	424
Buchan	2029	2033	365
Caledonia WTG fixed	2028	2032	8,201
Caledonia WTG floating	2030	2032	6,648
Cenos WTG	2031	2033	8,863
Cenos offshore substations	2031	2031	9,529
Ossian WTG	2031	2037	3,856
Ossian offshore substations	2031	2038	7,309
Seagreen 1A	2029	2032	1,882
Stromar WTG	2029	2032	199
Stromar offshore substations	2029	2031	199

4.2.2.12 The cumulative iPCoD results for harbour porpoise shows that the mean impacted population size in the NS MU is predicted to reduce to 98.51% of the size of the un-impacted population mean during the cumulative piling period and then remain at ~98.5%. The impacted population is predicted to continue on a stable trajectory, the same as the un-impacted population, albeit at a lower population level, over the 12 years after the end of the cumulative piling scenario (up to 2051;**Plate 4.1**).

Plate 4.1 Predicted population trajectories for the un-impacted (baseline) and impacted harbour porpoise cumulative iPCoD simulations for the NS MU. Results show a subset of 100 simulations of the 1,000 run. Piling is occurring between 2028 to 2039 inclusive (Appendix 11.2)



4.2.2.13 The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. However, the iPCoD modelling shows that the harbour porpoise population trajectory will not be affected by the impact, and population trend will remain stable and similar (~98.5%) to that of the un-impacted population. Therefore, the magnitude of impact is assessed as **low** for harbour porpoises.

Bottlenose dolphin – Coastal East Scotland Management Unit

4.2.2.14 The highest number of bottlenose dolphins within the CES MU predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.5**). The maximum cumulative number of bottlenose dolphins predicted to be disturbed during the pile driving campaign of the Project is 88 individuals (38.94% of the MU population) in 2033. The number of bottlenose dolphins predicted to be impacted by the Project represents 35.23% of this total.

4.2.2.15 The predicted extent of the cumulative disturbance is to a high proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **high** for bottlenose dolphins within the CES MU.

Table 4.5 Number of bottlenose dolphin in the CES MU predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Marram	1	EIA Report Dose-response					31			31		31	31			
Aspen	1	EIA Report Dose-response	5	5	5											
Ayre	2	EDR (15km)	14	14	14	14	14									
Berwick Bank	1	EIA Report Dose-response	4	4	4	4	4									
Bowdun	2	EDR (26km)	11	11	11	11	11									
Buchan	2	EDR (15km)		7	7	7	7	7								
Caledonia	1	EIA Report Dose-response	52	52	52	52										
Eastern Green Link 3	2	EDR (5km)	7	7	7	7	7									
Eastern Green Link 4	2	EDR (5km)	10	10	10	10	10									
Muir Mhòr	1	EIA Report Dose-response	8	8	8											
Ossian	1	EIA Report Dose-response			4	4	4	4	4	4	4	4				

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Seagreen 1A	1	EIA Report Dose-response	4	4	4	4										
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	14	14												
Stromar	2	EDR (15km)	9	9												
Total	1, 2	#	138	145	126	113	88	11	4	35	4	35	31	0	0	0
		% of MU	61.06	64.16	55.75	50.00	38.94	4.87	1.77	15.49	1.77	15.49	13.72	0.00	0.00	0.00

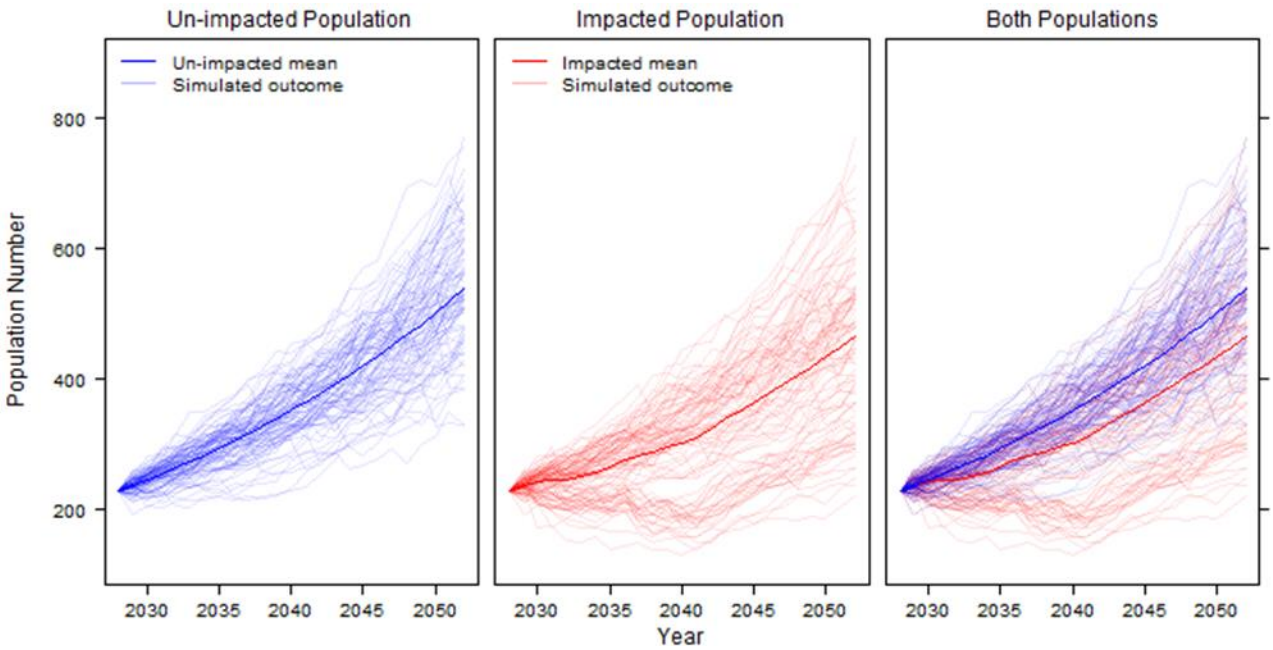
4.2.2.16 For the cumulative scenario for the CES MU, the disturbance numbers for bottlenose dolphins used in the modelling are presented in **Table 4.6**.

Table 4.6 Number of bottlenose dolphin in the CES MU disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day
Marram	2033	2039	31
Ayre offshore substations	2030	2033	0
Ayre WTG	2030	2033	0
Caledonia WTG fixed	2028	2032	52
Caledonia WTG floating	2030	2032	46

4.2.2.17 The results of the cumulative iPCoD modelling show that for CES MU, although the level of disturbance has the potential to result in changes at the population level, the impacted population is predicted to continue on an increasing trajectory at 85.40% to 100% of the size of the un-impacted population between 2028 – 2051 (**Plate 4.2**).

Plate 4.2 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin cumulative iPCoD simulations for the CES MU. Results show a subset of 100 simulations of the 1,000 run. Piling is occurring between 2028 to 2039 inclusive (Appendix 11.2)



4.2.2.18 Considering the worst-case scenario, up to 88 bottlenose dolphins within the CES MU (38.94% CES MU) are predicted to be disturbed across all projects considered in the CEA during years when piling is anticipated at the Project.

4.2.2.19 The cumulative impact of behavioural disturbance from increased underwater noise during installation is expected to occur intermittently, across a large spatial extent, and over a medium-term duration, with piling activities at the Project anticipated to span up to four years (non-consecutively). The likelihood of behavioural disturbance is considered high, with a moderate frequency of occurrence due to different projects undertaking piling at different times. Between 2028 and 2039, the level of disturbance predicted within the CES MU is expected to result in temporary changes in behaviour and / or distribution of individual bottlenose dolphin. In some cases, this may lead to reductions in lifetime reproductive success for a small number of individuals. However, results from iPCoD modelling indicate that, despite the cumulative nature of construction activities, the overall population trajectory remains unaffected. The population is predicted to continue increasing in size, demonstrating resilience to the level of disturbance anticipated.

4.2.2.20 As outlined in **Section 2**, the predicted numbers of animals disturbed per day are considered highly precautionary, and actual figures are expected to be lower. The piling parameters used in the iPCoD modelling adopt a conservative approach, assuming a greater number of piles will be installed compared to the Maximum Design Scenario (MDS) to allow for a higher proportion of foundations to be installed during the final construction phase. It is also assumed that all structures will require piled foundations; however, in practice, some foundations may use alternative methods that do not involve driven piles (see **Volume 1, Chapter 4: Project Description).** Furthermore, the modelling assumes continuous piling throughout the designated years, with one or two piles installed daily. This is unlikely to occur due to downtime caused by adverse weather or operational breaks. Finally, inherent limitations and precautionary assumptions within the iPCoD modelling should be noted (refer to Section 2.2 in **Volume 3, Appendix 11.2**). Considering the spatial and temporal extent of disturbance, the likelihood of behavioural change, and the modelling outputs, the cumulative impact of behavioural disturbance from increased underwater noise during installation is assessed as **medium** magnitude.

Bottlenose dolphin – Greater North Sea Management Unit

4.2.2.21 The highest number of bottlenose dolphins within the Greater North Sea (GNS) MU predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.7**). The maximum cumulative number of bottlenose dolphins predicted to be disturbed during the pile driving campaign of the Project is 430 individuals (21.27% of the MU population) in 2033. The number of bottlenose dolphins predicted to be impacted by the Project represents 4.65% of this total.

4.2.2.22 The predicted extent of the cumulative disturbance is to a moderate proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **high** for bottlenose dolphins within the GNS MU.

Table 4.7 Number of bottlenose dolphin in the GNS MU predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					20			20		20	20			
Arven	2	EDR (15km)		0	0	0	0									
Aspen	2	EIA Report Dose-response	40	40												
Ayre	2	EDR (15km)	3	3	3	3	3									
Bellrock	2	EDR (15km)	22	22												
Berwick Bank	1	EIA Report Dose-response	64	64	64	64	64									
Bowdun	2	EDR (26km)	64	64	64	64	64									
Broadshore	2	EDR (15km)	3													
Buchan	2	EDR (15km)		0	0	0	0	0								

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Caledonia	1	EIA Report Dose-response	35	35	35	35										
CampionWind	2	EDR (15km)	22	22												
Cenos	1	EIA Report Dose-response		273	273	273	273	273	273							
Eastern Green Link 3	2	EDR (5km)	3	3	3	3	3									
Eastern Green Link 4	2	EDR (5km)	3	3	3	3	3									
Morven	2	EDR (26km)	64													
Muir Mhòr	1	EIA Report Dose-response	74	74	74											
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	0	0												
Seagreen 1A	1	EIA Report Dose-response	2	2	2	2										

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	3	3												
Stromar	2	EDR (15km)	3	3												
Total	1, 2	#	405	611	521	447	430	273	273	20	0	20	20	0	0	0
		% of MU	20.03	30.22	25.77	22.11	21.27	13.50	13.50	0.99	0.00	0.99	0.99	0.00	0.00	0.00

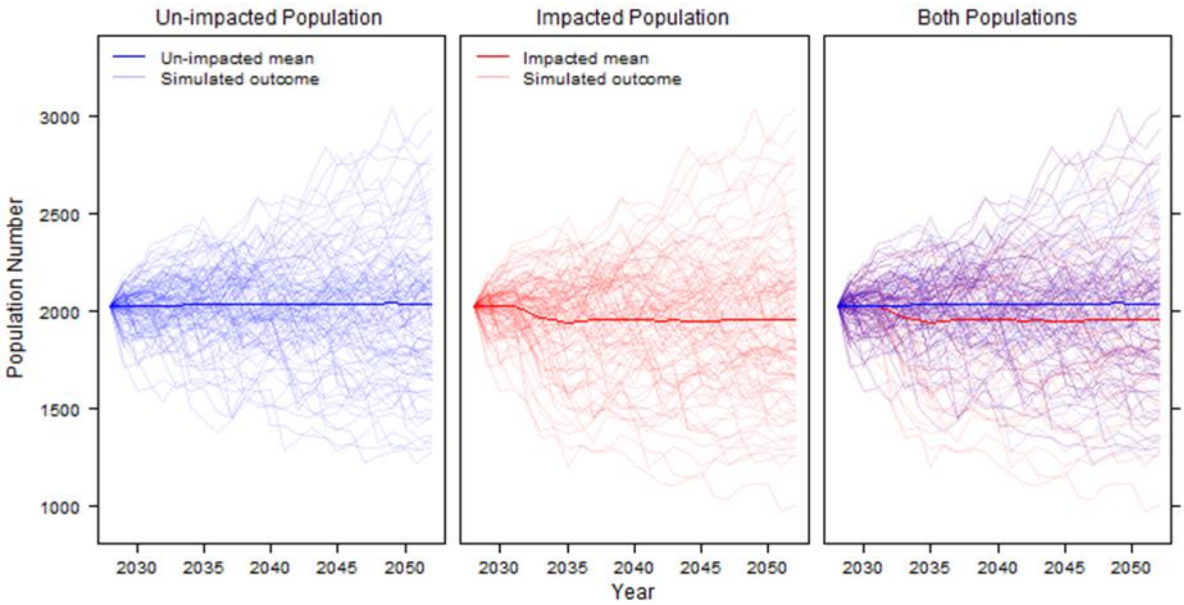
4.2.2.23 For the cumulative scenario for the GNS MU, the disturbance numbers for bottlenose dolphins used in the modelling are presented in **Table 4.8**.

Table 4.8 Number of bottlenose dolphins in the GNS MU disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day
MarramWind	2033	2039	20
Arven offshore substations	2030	2033	0
Arven WTG	2030	2033	0
Ayre offshore substations	2030	2033	0
Ayre WTG	2030	2033	0
Bowdun	2029	2032	0
Buchan	2029	2033	0
Caledonia WTG fixed	2028	2032	35
Caledonia WTG floating	2030	2032	27
Cenos WTG	2031	2033	254
Cenos offshore substations	2031	2031	273
Ossian WTG	2031	2037	0
Ossian offshore substations	2031	2038	0
Seagreen 1A	2029	2032	2
Stromar WTG	2029	2032	0
Stromar offshore substations	2029	2031	0

4.2.2.24 The results of the cumulative iPCoD modelling show that for GNS MU, although the level of disturbance has the potential to result in changes at the population level, the impacted population is predicted to continue on a stable trajectory at 95.88% to 100% of the size of the un-impacted population between 2028 – 2051 (**Plate 4.3**).

Plate 4.3 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin cumulative iPCoD simulations for the GNS MU (Appendix 11.2)



4.2.2.25 Considering the worst-case scenario, up to 1,056 bottlenose dolphins within the GNS MU (52.23% GNS MU) are predicted to be disturbed across all projects considered in the CEA during years when piling is anticipated at the Project. The results of the cumulative iPCoD modelling show the impacted population is predicted to continue on a stable trajectory at 95.88% to 100% of the size of the un-impacted population.

4.2.2.26 The cumulative impact of behavioural disturbance from increased underwater noise during installation is expected to occur intermittently, across a large spatial extent, and over a medium-term duration, with piling activities at the Project anticipated to span up to four years. The likelihood of behavioural disturbance is considered high, with a moderate frequency of occurrence due to different projects undertaking piling at different times. Between 2028 and 2039, the level of disturbance predicted within the GNS MU is expected to result in temporary changes in behaviour and / or distribution of individual bottlenose dolphin. In some cases, this may lead to reductions in lifetime reproductive success for a small number of individuals.

4.2.2.27 However, results from iPCoD modelling indicate that, despite the cumulative nature of construction activities, the overall population trajectory remains unaffected. The population is predicted to continue on a stable trajectory, despite the initial impacted population reduction estimate to 96.07% of the un-impacted population by 2039. Considering the spatial and temporal extent of disturbance, the likelihood of behavioural change, and the modelling outcomes, the cumulative impact of behavioural disturbance from increased underwater noise during installation is assessed as being of **medium** magnitude.

Risso's dolphin

4.2.2.28 The highest number of Risso's dolphins predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.9**). The maximum cumulative number of Risso's dolphins predicted to be disturbed during the pile driving campaign of the Project is 1,508 individuals (12.30% of the MU population) in 2033. The number of Risso's dolphins predicted to be impacted by the Project represents 91.58% of this total.

4.2.2.29 There are no estimations for the potential changes in population over time for Risso's dolphin as data are lacking on their behaviour and ecology; therefore, it is not possible to include them in an iPCoD model. The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **medium** for Risso's dolphins.

Table 4.9 Number of Risso's dolphin predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					1,381			1,381		1,381	1,381			
Arven	2	EDR (15km)		50	50	50	50									
Aspen	2	EIA Report Dose-response	1,250	1,250												
Ayre	2	EDR (15km)	27	27	27	27	27									
Bellrock	2	EDR (15km)	0	0												
Bowdun	2	EDR (26km)	0	0	0	0	0									
Broadshore	2	EDR (15km)	27													
Buchan	2	EDR (15km)		50	50	50	50	50								
Caledonia	1	EIA Report Dose-response	1	1	1	1										
CampionWind	2	EDR (15km)	0	0												

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Cenos	1	EDR (15km)		0	0	0	0	0	0							
Eastern Green Link 3	2	EDR (5km)	0	0	0	0	0									
Eastern Green Link 4	2	EDR (5km)	0	0	0	0	0									
Morven	2	EDR (26km)	0													
Muir Mhòr	1	EIA Report Dose-response	450	450	450											
Ossian	1	EDR (15km)			0	0	0	0	0	0	0	0				
Scaraben	2	EDR (15km)	50	50												
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	6	6												
Stromar	2	EDR (15km)	27	27												
West of Orkney	1	EIA Report Dose-response	121	121												
Total	1, 2	#	1,959	2,032	578	128	1,508	50	0	1,381	0	1,381	1,381	0	0	0

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
		% of MU	15.98	16.57	4.71	1.04	12.30	0.41	0.00	11.26	0.00	11.26	11.26	0.00	0.00	0.00

Atlantic white-sided dolphin

4.2.2.30 The highest number of Atlantic white-sided dolphins predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2033, which coincides with the expected pile driving campaign of the Project (**Table 4.10**). The maximum cumulative number of Atlantic white-sided dolphins predicted to be disturbed during the expected pile driving campaign of the Project is estimated as 342 individuals (1.89% of MU population). The number of Atlantic white-sided dolphins predicted to be impacted by the Project represents 84.21% of this total.

4.2.2.31 There are no estimations for the potential changes in population over time for Atlantic white-sided dolphin as data are lacking on their behaviour and ecology; therefore, it is not possible to include them in an iPCoD model. The predicted extent of the cumulative disturbance is to a small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **low** for Atlantic white-sided dolphins.

Table 4.10 Number of Atlantic white-sided dolphin predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					288			288		288	288			
Arven	2	EDR (15km)		11	11	11	11									
Aspen	2	EIA Report Dose-response	178	178												
Ayre	2	EDR (15km)	0	0	0	0	0									
Bellrock	2	EDR (15km)	8	8												
Bowdun	2	EDR (26km)	22	22	22	22	22									
Broadshore	2	EDR (15km)	0													
Buchan	2	EDR (15km)		11	11	11	11	11								
CampionWind	2	EDR (15km)	8	8												
Cenos	1	EDR (15km)		8	8	8	8	8	8							
Eastern Green Link 3	2	EDR (5km)	1	1	1	1	1									

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Eastern Green Link 4	2	EDR (5km)	1	1	1	1	1									
Morven	2	EDR (26km)	8													
Scaraben	2	EDR (15km)	11	11												
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	2	2												
Stromar	2	EDR (15km)	0	0												
West of Orkney	1	EDR (26km)	0	0												
Total	1, 2	#	239	261	54	54	342	19	8	288	0	288	288	0	0	0
		% of MU	1.32	1.44	0.30	0.30	1.89	0.10	0.04	1.59	0.00	1.59	1.59	0.00	0.00	0.00

Short-beaked common dolphin

4.2.2.32 The highest number of short-beaked common dolphins predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2033, 3036, 3038 and 3039, which coincides with the expected pile driving campaign of the Project (**Table 4.11**). The maximum cumulative number of short-beaked common dolphins predicted to be disturbed during the pile driving campaign of the Project is 335 individuals (0.10% of the MU population). The number of short-beaked common dolphins predicted to be impacted by the Project represents all of this total.

4.2.2.33 There are no estimations for the potential changes in population over time for short-beaked common dolphin as data are lacking on their behaviour and ecology; therefore, it is not possible to include them in an iPCoD model. The predicted extent of the cumulative disturbance is to a small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **low** for short-beaked common dolphins.

Table 4.11 Number of short-beaked common dolphin predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					335			335		335	335			
Arven	2	EDR (15km)		0	0	0	0									
Ayre	2	EDR (15km)	0	0	0	0	0									
Bellrock	2	EDR (15km)	0	0												
Bowdun	2	EDR (26km)	0	0	0	0	0									
Broadshore	2	EDR (15km)	0													
Buchan	2	EDR (15km)		0	0	0	0	0								
Caledonia	1	EIA Report Dose-response	4	4	4	4										
CampionWind	2	EDR (15km)	0	0												
Cenos	1	EDR (15km)		0	0	0	0	0	0							
Eastern Green Link 3	2	EDR (5km)	0	0	0	0	0									

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Eastern Green Link 4	2	EDR (5km)	0	0	0	0	0									
Morven	2	EDR (26km)	0													
Salamander	1	EDR (15km)														
Scaraben	2	EDR (15km)	0	0												
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	0	0												
Stromar	2	EDR (15km)	0	0												
West of Orkney	1	EIA Report Dose-response	90	90												
Total	1, 2	#	94	94	4	4	335	0	0	335	0	335	335	0	0	0
		% of MU	0.03	0.03	0.00	0.00	0.10	0.00	0.00	0.10	0.00	0.10	0.10	0.00	0.00	0.00

White-beaked dolphin

4.2.2.34 The highest number of white-beaked dolphin predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030 which does not coincide with the expected pile driving campaign of the Project (**Table 4.12**). The maximum cumulative number of white-beaked dolphin predicted to be disturbed during the expected pile driving campaign of the Project is estimated as 11,724 individuals (26.68% of MU population) in 2033. The number of white-beaked dolphin predicted to be impacted by the Project represents 69.78% of this total.

4.2.2.35 There are no estimations for the potential changes in population over time for white-beaked dolphin as data are lacking on their behaviour and ecology; therefore, it is not possible to include them in an iPCoD model. The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **high** for white-beaked dolphins.

Table 4.12 Number of white-beaked dolphin predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					8,181			8,181		8,181	8,181			
Arven	2	EDR (15km)		126	126	126	126									
Aspen	2	EIA Report Dose-response	3,644	3,644												
Ayre	2	EDR (15km)	96	96	96	96	96									
Bellrock	2	EDR (15km)	57	57												
Berwick Bank	1	EIA Report Dose-response	516	516	516	516	516									
Bowdun	2	EDR (26km)	170	170	170	170	170									
Broadshore	2	EDR (15km)	96													

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Buchan	2	EDR (15km)		126	126	126	126	126								
Caledonia	1	EIA Report Dose-response	3,114	3,114	3,114	3,114										
CampionWind	2	EDR (15km)	57	57												
Cenos	1	EIA Report Dose-response		964	964	964	964	964	964							
Eastern Green Link 3	2	EDR (5km)	7	7	7	7	7									
Eastern Green Link 4	2	EDR (5km)	7	7	7	7	7									
Morven	2	EDR (26km)	57													
Muir Mhòr	1	EIA Report Dose-response	6,850	6,850	6,850											
Ossian	1	EIA Report Dose-response			1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531				

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	126	126												
Seagreen 1A	1	EIA Report Dose-response	764	764	764	764										
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	14	14												
Stromar	2	EDR (15km)	96	96												
West of Orkney	1	EIA Report Dose-response	1,709	1,709												
Total	1, 2	#	17,380	18,443	14,271	7,421	11,72 4	2,621	2,495	9,712	1,531	9,712	8,181	0	0	0
		% of MU	39.54	41.96	32.47	16.88	26.68	5.96	5.68	22.10	3.48	22.10	18.61	0.00	0.00	0.00

Minke whale

4.2.2.36 The highest number of minke whales predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030 which does not coincide with the expected pile driving campaign of the Project (**Table 4.13**). The maximum cumulative number of minke whales predicted to be disturbed during the expected pile driving campaign of the Project is estimated as 1,892 individuals (9.40% of MU population) in 2033. The number of minke whales predicted to be impacted by the Project represents 52.01% of this total.

4.2.2.37 The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **medium** for minke whales.

Table 4.13 Number of minke whale predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					984			984		984	984			
Arven	2	EDR (15km)		9	9	9	9									
Aspen	2	EIA Report Dose-response	1,368	1,368												
Ayre	2	EDR (15km)	9	9	9	9	9									
Bellrock	2	EDR (15km)	30	30												
Berwick Bank	1	EIA Report Dose-response	82	82	82	82	82									
Bowdun	2	EDR (26km)	89	89	89	89	89									
Broadshore	2	EDR (15km)	9													
Buchan	2	EDR (15km)		9	9	9	9	9								
Caledonia	1	EIA Report Dose-response	502	502	502	502										

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
CampionWind	2	EDR (15km)	30	30												
Cenos	1	EIA Report Dose-response		384	384	384	384	384	384							
Eastern Green Link 3	2	EDR (5km)	4	4	4	4	4									
Eastern Green Link 4	2	EDR (5km)	4	4	4	4	4									
Morven	2	EDR (26km)	30													
Muir Mhòr	1	EIA Report Dose-response	777	777	777											
Ossian	1	EDR (15km)			30	30	30	30	30	30	30	30				
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	9	9												
Seagreen 1A	1	EIA Report Dose-response	89	89	89	89										
Spittal to Peterhead	1	EDR (5km)	4	4												

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Subsea Cable link																
Stromar	2	EDR (15km)	9	9												
West of Orkney	1	EIA Report Dose-response	90	90												
Total	1, 2	#	3,135	3,498	2,276	1,499	1,892	711	702	1,302	318	1,302	984	0	0	0
		% of MU	15.58	17.39	11.31	7.45	9.40	3.53	3.49	6.47	1.58	6.47	4.89	0.00	0.00	0.00

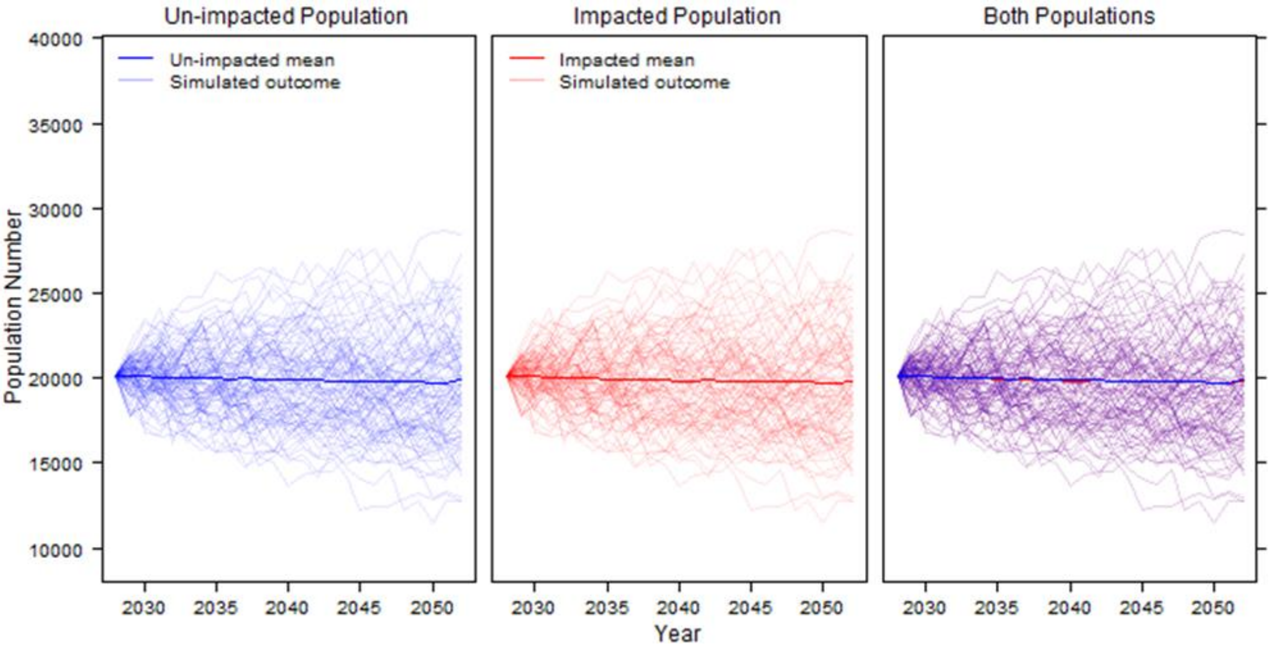
4.2.2.38 For the cumulative scenario for the CGNS MU, the disturbance numbers for minke whale used in the iPCoD modelling are presented in **Table 4.14.**

Table 4.14 Number of minke whale in the CGNS MU disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day
MarramWind	2033	2039	984
Arven offshore substations	2030	2033	9
Arven WTG	2030	2033	9
Ayre offshore substations	2030	2033	9
Ayre WTG	2030	2033	9
Bowdun	2029	2032	30
Buchan	2029	2033	9
Caledonia WTG fixed	2028	2032	502
Caledonia WTG floating	2030	2032	415
Cenos WTG	2031	2033	357
Cenos offshore substations	2031	2031	384
Ossian WTG	2031	2037	168
Ossian offshore substations	2031	2038	318
Seagreen 1A	2029	2032	89
Stromar WTG	2029	2032	9
Stromar offshore substations	2029	2031	9

4.2.2.39 The cumulative iPCoD results show that the mean impacted population size of minke whale in the CGNS MU is predicted to remain within 99% of the size of the un-impacted population mean. The impacted population is predicted to continue on a stable trajectory, the same as the un-impacted population, over the 12 years after the end of the cumulative piling scenario (up to 2051; **Plate 4.4**).

Plate 4.4 Predicted population trajectories for the un-impacted (baseline) and impacted minke whale cumulative iPCoD simulations for the CGNS MU. Results show a subset of 100 simulations of the 1,000 run. Piling is occurring between 2028 to 2039 inclusive (Appendix 11.2)



4.2.2.40 The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. However, the iPCoD modelling shows that the minke whale population trajectory will not be affected by the impact, and the size remains similar (approximately 99%) to that of the un-impacted population. Therefore, the magnitude of impact is assessed as **low** for minke whales.

Humpback whale

4.2.2.41 Humpback whales have been included in the assessment due to an increase in opportunistic sightings along the East coast of Scotland; however, due to an absence of a defined MU, or abundance and density estimates, there are insufficient empirical data to support a quantitative assessment for this species. As described in **Volume 1, Chapter 11: Marine Mammals**, there is limited information on the behavioural responses of humpback whales to underwater noise, particularly piling noise. Low-frequency noise generated during piling may overlap with the hearing range of low frequency cetaceans such as minke and humpback whales; however, studies on behavioural responses to sound (for example, seismic airguns) demonstrated that humpback whales responded mildly and still vocalised within their normal behavioural repertoire indicating a reasonable tolerance and high recoverability to disturbance from airguns. Taking this into account, the seasonal occurrence of the species in the area and comparing the assessment of minke whale, which are believed to have a similar sensitivity to piling noise, the predicted extent of the cumulative disturbance is thought to affect a small proportion of the population that visit Scottish waters. Therefore, the magnitude of impact is assessed as **low** for humpback whales.

Grey seal

4.2.2.42 The highest number of grey seals predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.15**). The maximum cumulative number of grey seals predicted to be disturbed during the expected pile driving campaign of the Project is estimated as 2,419 individuals (5.96% of MU population) in 2033. The number of grey seals predicted to be impacted by the Project represents 2.69% of this total.

4.2.2.43 The predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **medium** for grey seals.

Table 4.15 Number of grey seal predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					65			65		65	65			
Aspen	2	EIA Report Dose-response	114	114												
Ayre	2	EDR (15km)	457	457	457	457	457									
Bellrock	2	EDR (15km)	79	79												
Berwick Bank	1	EIA Report Dose-response	705	705	705	705	705									
Bowdun	2	EDR (26km)	237	237	237	237	237									
Buchan	2	EDR (15km)		457	457	457	457	457								
CampionWind	2	EDR (15km)	79	79												
Cenos	1	EIA Report Dose-response		137	137	137	137	137	137							

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Eastern Green Link 3	2	EDR (5km)	9	9	9	9	9									
Eastern Green Link 4	2	EDR (5km)	9	9	9	9	9									
Morven	2	EDR (26km)	237													
Muir Mhòr	1	EIA Report Dose-response	1,176	1,176	1,176											
Ossian	1	EIA Report Dose-response			343	343	343	343	343	343	343	343				
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	457	457												
Seagreen 1A	1	EIA Report Dose-response	398	398	398	398										
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	9	9												

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Stromar	2	EDR (15km)	457	457												
West of Orkney	1	EIA Report Dose-response	2,887	2,887												
Total	1, 2	#	7,310	7,667	3,928	2,752	2,419	937	480	408	343	408	65	0	0	0
		% of MU	18.02	18.90	9.68	6.78	5.96	2.31	1.18	1.01	0.85	1.01	0.16	0.00	0.00	0.00

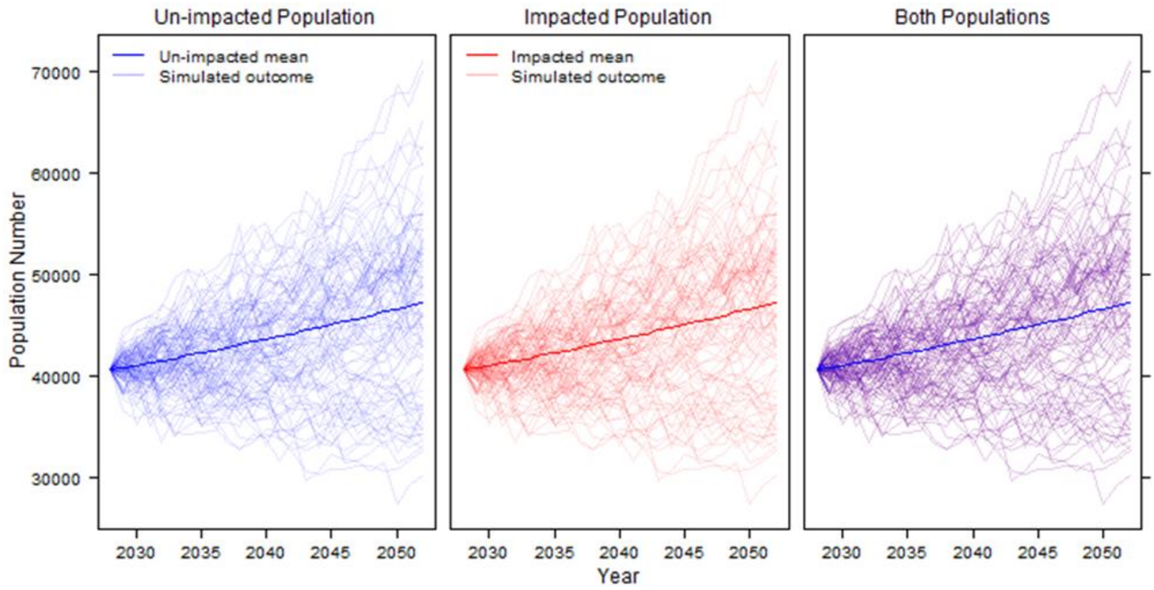
4.2.2.44 For the cumulative scenario for the East Scotland and North Coast and Orkney SMAs, the disturbance numbers for grey seals used in the iPCoD modelling are presented in **Table 4.16**.

Table 4.16 Number of grey seals in the East Scotland and North Coast and Orkney SMAs disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day
MarramWind	2033	2039	183
Ayre offshore substations	2030	2033	457
Ayre WTG	2030	2033	457
Bowdun	2029	2032	79
Buchan	2029	2033	457
Cenos WTG	2031	2033	127
Cenos offshore substations	2031	2031	137
Ossian WTG	2031	2037	131
Ossian offshore substations	2031	2038	343
Seagreen 1A	2029	2032	398
Stromar WTG	2029	2032	457
Stromar offshore substations	2029	2031	457

4.2.2.45 The results of the cumulative iPCoD modelling show that for East Scotland and North Coast and Orkney SMA, is predicted to remain at 100% of the size of the un-impacted population mean. The impacted population is predicted to continue on an increasing trajectory, the same as the un-impacted population between 2028 – 2051 (**Plate 4.5**).

Plate 4.5 Predicted population trajectories for the un-impacted (baseline) and impacted grey seal cumulative iPCoD simulations for the East Scotland and North Coast and Orkney SMAs (Appendix 11.2)



4.2.2.46 Considering the worst-case scenario, up to 8,369 grey seals within the East Scotland and North Coast and Orkney SMAs (46.17% of the SMAs) are predicted to be disturbed across all projects considered in the CEA during years when piling is anticipated at the Project. The results of the cumulative iPCoD modelling show the impacted population is predicted to continue on an increasing trajectory at 100% of the size of the un-impacted population.

4.2.2.47 Behavioural disturbance from pile driving is expected to occur intermittently across a wide area and over a medium-term period, with piling activities taking place between 2028 and 2039. Disturbance is likely, occurring at moderate frequency due to overlapping construction schedules across different projects. Within the East Scotland and North Coast and Orkney SMAs, this disturbance may lead to temporary changes in individual behaviour and distribution, potentially affecting lifetime reproductive success for a small number of animals. However, cumulative iPCoD modelling confirms that these impacts will not affect overall population size or trajectory. Therefore, the cumulative impact of behavioural disturbance from increased underwear noise during installation is assessed as being of **low** magnitude.

Harbour seal

4.2.2.48 The highest number of harbour seals predicted to be disturbed across Tier 1 and 2 projects between 2029 and 2042 is in 2030, which does not coincide with the expected pile driving campaign of the Project (**Table 4.17**). The maximum cumulative number of harbour seals predicted to be disturbed during the expected pile driving campaign of the Project is estimated as 77 individuals (3.30% of MU population) in 2033. The number of harbour seals predicted to be impacted by the Project represents 1.30% of this total.

4.2.2.49 The predicted extent of the cumulative disturbance is to a small proportion of the MU population, though it will occur across multiple projects over several years. Behavioural changes are expected from each disturbance event that an individual is exposed to, which may lead to longer-term but temporary and recoverable changes in the distribution of the population. The changes in behaviour and / or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory or viability. Therefore, the magnitude of impact is assessed as **medium** for harbour seals.

Table 4.17 Number of harbour seal predicted to be disturbed per day during years with estimated pile driving activities per project; blue = concept / in planning / consenting, orange = construction, green = operational

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
MarramWind	1	EIA Report Dose-response					1			1		1	1			
Aspen	2	EIA Report Dose-response	1	1												
Ayre	2	EDR (15km)	26	26	26	26	26									
Bellrock	2	EDR (15km)	5	5												
Berwick Bank	1	EIA Report Dose-response	2	2	2	2	2									
Bowdun	2	EDR (26km)	15	15	15	15	15									
Buchan	2	EDR (15km)		26	26	26	26	26								
CampionWind	2	EDR (15km)	5	5												
Cenos	1	EDR (15km)		5	5	5	5	5	5							
Eastern Green Link 3	2	EDR (5km)	1	1	1	1	1									
Eastern Green Link 3	2	EDR (5km)	1	1	1	1	1									

Project	Tier	Source	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Morven	2	EDR (26km)	15													
Muir Mhòr	1	EIA Report Dose-response	1	1	1											
Salamander	1	EIA Report Dose-response														
Scaraben	2	EDR (15km)	26	26												
Seagreen 1A	1	EIA Report Dose-response	51	51	51	51										
Spittal to Peterhead Subsea Cable link	1	EDR (5km)	1	1												
Stromar	2	EDR (15km)	26	26												
West of Orkney	1	EIA Report Dose-response	176	176												
Total	1, 2	#	352	368	128	127	77	31	5	1	0	1	1	0	0	0
		% of MU	15.08	15.77	5.48	5.44	3.30	1.33	0.21	0.04	0.00	0.04	0.04	0.00	0.00	0.00

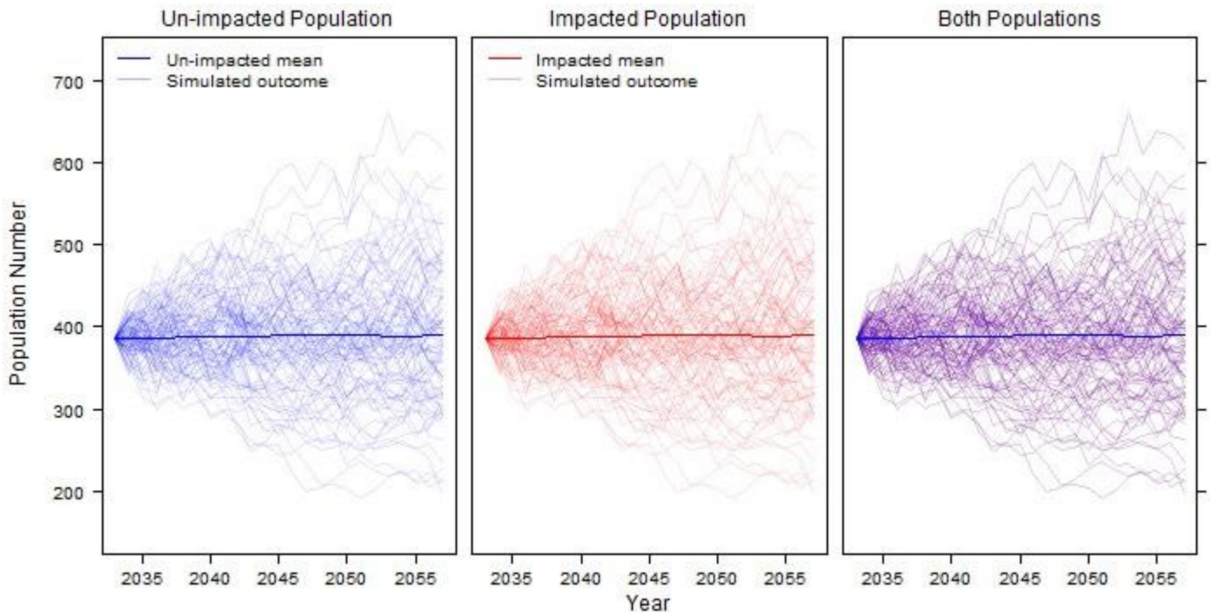
4.2.2.50 For the cumulative scenario for the East Scotland and North Coast and Orkney SMAs, the disturbance numbers for harbour seals used in the modelling are presented in **Table 4.18**. Numbers disturbed are displayed separately per SMA due to the differing trends in population sizes over time, as shown in **Plate 4.6**.

Table 4.18 Number of harbour seals in the East Scotland and North Coast and Orkney SMAs disturbed per piling day per offshore wind farm development in the cumulative iPCoD simulation

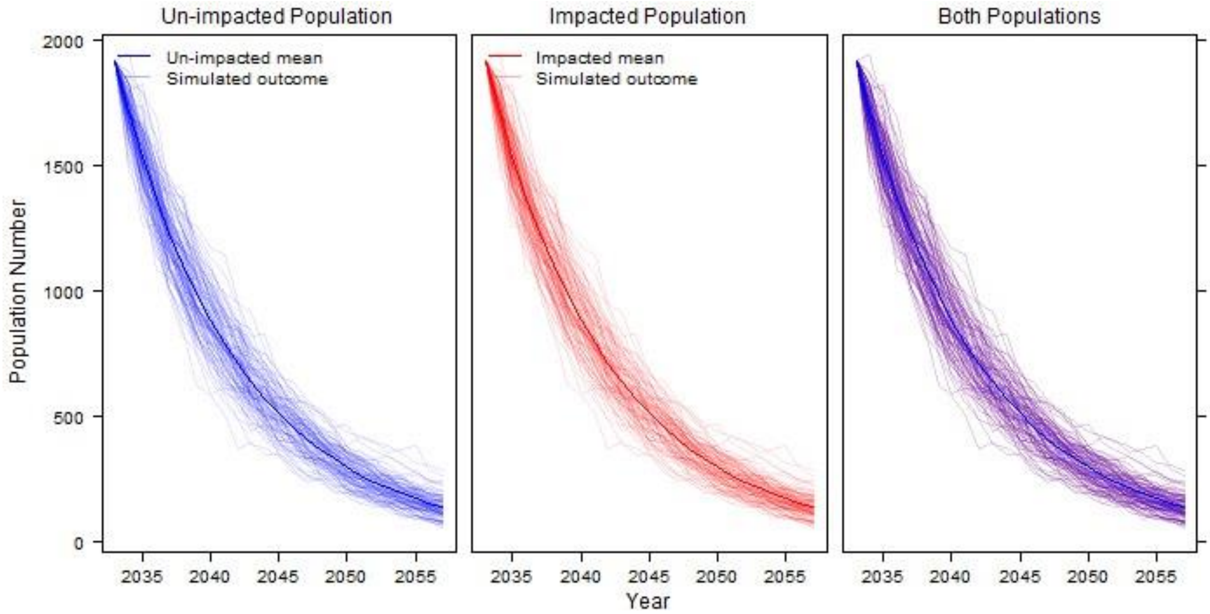
Offshore wind farm	Piling start year	Piling end year	Number of animals disturbed per day (ES SMA)	Number of animals disturbed per day (NC&O SMA)
MarramWind	2033	2039	1	0
Aspen	2028	2030	1	0
Ayre	2029	2033	0	26
Bellrock	2028	2030	5	0
Berwick Bank	2025	2033	3	0
Bowdun	2028	2032	15	0
Buchan	2029	2033	0	26
CampionWind	2026	2030	5	0
Cenos	2030	2035	5	0
Morven	2028	2029	15	0
Muir Mhòr	2029	2031	1	0
Ossian	2031	2038	5	0
Salamander	2028	2028	4	0
Scaraben	2029	2030	0	26
Seagreen 1A	2029	2032	51	0
Stromar	2028	2030	0	26
West of Orkney	2028	2030	0	176

4.2.2.51 The results of the cumulative iPCoD modelling show that for East Scotland and North Coast and Orkney SMA, is predicted to remain at 100% of the size of the un-impacted population mean. The impacted population in the East Scotland SMA is predicted to continue on an stable trajectory and the North Coast and Orkney SMA is predicted to continue on a declining trajectory, the same as the un-impacted population between 2028 to 2051 (**Plate 4.6**).

Plate 4.6 Predicted population trajectories for the un-impacted (baseline) and impacted harbour seal cumulative iPCoD simulations for the East Scotland (A) and North Coast and Orkney (B) SMAs (Appendix 11.2)



(A)



(B)

4.2.2.52 Considering the worst-case scenario, up to 369 harbour seals within the East Scotland and North Coast and Orkney SMAs (2.04% of the SMAs) are predicted to be disturbed across all projects considered in the CEA during years when piling is anticipated at the Project. The results of the cumulative iPCoD modelling show the impacted population is predicted to continue on an increasing trajectory at 100% of the size of the un-impacted population.

4.2.2.53 Behavioural disturbance from pile driving is expected to occur intermittently across a wide area and over a medium-term period, with piling activities taking place between 2028 and 2039. Disturbance is likely, occurring at moderate frequency due to overlapping construction schedules across different projects. Within the East Scotland and North Coast and Orkney SMAs, this disturbance may lead to temporary changes in individual behaviour and distribution, potentially affecting lifetime reproductive success for a small number of animals. However, cumulative iPCoD modelling confirms that these impacts will not affect overall population size or trajectory. Therefore, the cumulative impact of behavioural disturbance from increased underwear noise during installation is assessed as being of **low** magnitude.

Significance of cumulative effect

4.2.2.54 A summary of the cumulative impact magnitude, receptor sensitivity and significance of cumulative effect for marine mammal receptors are presented in **Table 4.19**.

4.2.2.55 The magnitude of the cumulative impact of disturbance from increased underwater noise during installation (for example, anchor piles) is deemed to be **low** for harbour porpoise, Atlantic white-sided dolphin, short-beaked common dolphin, minke whale and humpback whale, **medium** for bottlenose dolphin, Risso's dolphin, grey seal and harbour seal, and **high** for white-beaked dolphin. The sensitivity of all marine mammal receptors to cumulative disturbance is **low**. The cumulative effect of disturbance from increased underwater noise during installation (for example, anchor piles) will, therefore, be of **Minor** (**Not Significant**) significance for bottlenose dolphin, Risso's dolphin and white-beaked dolphin, and of **Negligible** (**Not Significant**) significance for all remaining marine mammal receptors, both of which are not significant in EIA terms.

Table 4.19 Significance of impact C6: disturbance from increased underwater noise during installation of driven piles

Receptor	Magnitude	Sensitivity	Significance
Harbour porpoise	Low	Low	**Negligible** (**Not Significant**).
Bottlenose dolphin – CES	Medium	Low	**Minor** (**Not Significant**).
Bottlenose dolphin – GNS	Medium	Low	**Minor** (**Not Significant**).
Risso's dolphin	Medium	Low	**Minor** (**Not Significant**).
Atlantic white-sided dolphin	Low	Low	**Negligible** (**Not Significant**).
White-beaked dolphin	High	Low	**Minor** (**Not Significant**).
Short-beaked common dolphin	Low	Low	**Negligible** (**Not Significant**).
Minke whale	Low	Low	**Negligible** (**Not Significant**).
Humpback whale	Low	Low	**Negligible** (**Not Significant**).
Harbour seal	Medium	Low	**Minor** (**Not Significant**).
Grey seal	Medium	Low	**Minor** (**Not Significant**).

4.3 Operation and maintenance cumulative effects

4.3.1 Impact O1: disturbance from electromagnetic fields from cables

Sensitivity of receptor

4.3.1.1 During the Project alone assessment, harbour porpoise, dolphin species and whale species were assessed as having a low sensitivity to EMF from cables (see Section 11.10.1 in **Volume 1, Chapter 11: Marine Mammals**). Therefore, for the purpose of the CEA, the sensitivity of harbour porpoise, dolphin species and whale species to EMF from cables is **low**.

4.3.1.2 There is currently no evidence to suggest that seal species exhibit magnetic sensitivity (Normandeau Associates *et al.*, 2011). As such, there is no risk to seal species from EMF from cables. Therefore, as assessed during the Project alone assessment (see Section 11.10.1 in **Volume 1, Chapter 11: Marine Mammals**), the overall sensitivity of seal species to EMF from cables is considered to be **negligible**.

Magnitude of cumulative impact

4.3.1.3 In line with the findings of the Project's standalone assessment (see Section 11.10.1 in **Volume 1, Chapter 11: Marine Mammals**), any impacts to marine mammal receptors resulting from EMF are expected to be highly localised. Research indicates that magnetic field strength diminishes rapidly with distance from the source, falling to negligible levels approximately 10 metres from the cable (Normandeau Associates Inc. *et al.,* 2011). This suggests that the spatial extent of any EMF-related disturbance will be minimal.

4.3.1.4 To further mitigate potential impacts, all projects included in the CEA will likely include the implementation of cable burial or protection plan (for example, M-054 and M-057 for the Project) as part of its embedded environmental measures. These plans outline specific actions that are designed to primarily protect the cable, but it also helps to reduce the exposure of marine mammals to EMF and thereby lower the magnitude of any associated impacts.

4.3.1.5 Given the localised nature of EMF emissions and the mitigation measures in place, it is anticipated that any effects on marine mammals will be confined to the OAA and the export corridor of the respective projects. As a result, the likelihood of cumulative impacts arising from EMF is considered to be very low. Any cumulative effects that do occur would be limited in scope, potentially affecting only a small segment of the population, and would not result in a greater magnitude of impact than that identified in the standalone assessment. Consequently, the overall magnitude of impact from EMF on marine mammal receptors is assessed as **low**.

Significance of cumulative effect

4.3.1.6 A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for marine mammal receptors is presented in **Table 4.20.**

4.3.1.7 The cumulative impact of disturbance from EMF from cables is assessed as being of **low** magnitude across all marine mammal receptors. While most receptors are considered to have **low** sensitivity, grey seals and harbour seals are, assessed as having **negligible** sensitivity to EMF exposure. As a result, the overall cumulative effect of disturbance from EMF emitted from cables is considered to be of **Negligible (Not Significant)** significance, which is not significant in EIA terms.

Table 4.20 Significance of Impact O1: disturbance from EMF from cables

Receptor	Magnitude	Sensitivity	Significance
Harbour porpoise	Low	Low	Negligible (Not Significant).
Bottlenose dolphin	Low	Low	Negligible (Not Significant).
Risso's dolphin	Low	Low	Negligible (Not Significant).
Atlantic white-sided dolphin	Low	Low	Negligible (Not Significant).
White-beaked dolphin	Low	Low	Negligible (Not Significant).
Short-beaked common dolphin	Low	Low	Negligible (Not Significant).
Minke whale	Low	Low	Negligible (Not Significant).
Humpback whale	Low	Low	Negligible (Not Significant).
Harbour seal	Low	Negligible	Negligible (Not Significant).
Grey seal	Low	Negligible	Negligible (Not Significant).

4.3.2 Impact O5: entanglement in lines and cables for example, mooring lines and array cables

Sensitivity of receptor

4.3.2.1 During the Project alone assessment, all marine mammal receptors were assessed as having a high sensitivity to secondary entanglement in lines and cables (see Section 11.10.6 in **Volume 1, Chapter 11: Marine Mammals**). The large diameter of typical mooring lines makes primary entanglement unlikely due to the weight which prevents the lines from looping and entangling marine life. Due to this, the assessment of entanglement within this CEA refers to secondary entanglement only. Following on from the conclusion of the Project alone assessment, the sensitivity of all marine mammal receptors to cumulative secondary entanglement in lines and cables is **high**.

Magnitude of cumulative impact

4.3.2.2 There are numerous floating offshore wind projects currently being developed in Scottish waters. A full list of these projects considered in the CEA are described in **Table 3.1** All projects have acknowledged that marine debris accumulating on floating lines and cables (secondary entanglement) could lead to negative interactions between mobile marine species and project infrastructure.

4.3.2.3 For those projects with an EIA in the public domain, comprehensive details were provided regarding their entanglement risk monitoring strategies. These include plans for monitoring large strains on mooring lines, conducting surveys with remotely operated vehicles, removing debris from infrastructure, and implementing reporting procedures (Atkins, 2016; Buchan Offshore Wind, 2025 Flotation Energy, 2023; Green Volt, 2023; Muir Mhòr, 2024; OWFL, 2024; Pentland Floating Offshore Wind Farm, 2022; Salamander Offshore Wind Farm, 2023; Statoil, 2015; Xodus Group Ltd., 2024). Therefore, there is a general recognition within the industry of the need to implement mitigation strategies to reduce the risk of entanglement, and these are being implemented by projects. The potential for secondary entanglement is confined to each project's OAA, making it spatially limited and temporally restricted to the project lifetime, as the dynamic infrastructure will be removed from the water column following the completion of each project's O&M stage. Knowledge of the scale of entanglement is unknown, however it is considered likely that it would only affect a very small proportion of the population and is therefore unlikely to influence overall population trends. Based on this, the magnitude of the cumulative effect is considered to be **low**.

Significance of cumulative effect

4.3.2.4 A summary of the cumulative impact magnitude, receptor sensitivity and significance of cumulative effect for marine mammal receptors are presented in **Table 4.21**.

4.3.2.5 The magnitude of the cumulative impact of entanglement is deemed to be **low,** with the sensitivity of all receptors being **high**. The cumulative effect of entanglement in lines and cable will, therefore, be of **Minor** (**Not Significant**) significance, which is not significant in EIA terms.

Table 4.21 Significance of impact O5: entanglement in lines and cables for example, mooring lines and array cables

Receptor	Magnitude	Sensitivity	Significance
Harbour porpoise	Low	High	Minor (Not Significant).
Bottlenose dolphin	Low	High	Minor (Not Significant).
Risso's dolphin	Low	High	Minor (Not Significant).
Atlantic white-sided dolphin	Low	High	Minor (Not Significant).
White-beaked dolphin	Low	High	Minor (Not Significant).
Short-beaked common dolphin	Low	High	Minor (Not Significant).
Minke whale	Low	High	Minor (Not Significant).
Humpback whale	Low	High	Minor (Not Significant).
Harbour seal	Low	High	Minor (Not Significant).
Grey seal	Low	High	Minor (Not Significant).

4.3.3 Impact O6: disturbance from increased underwater noise for example, operational noise and mooring noise

Sensitivity of receptor

4.3.3.1 During the Project alone assessment, harbour porpoise, dolphin species and seal species were assessed as having a negligible sensitivity to operational noise and mooring noise (see Section 11.10.7 in **Volume 1, Chapter 11: Marine Mammals**). Therefore, for the purpose of the CEA, the sensitivity of harbour porpoise, dolphin species and seal species to operational noise and mooring noise is **negligible**.

4.3.3.2 Minke whales and humpback whales have greater sensitivity to low frequency noise such as those produced by operational noise and mooring noise. As assessed during the Project alone assessment (see Section 11.10.7 in **Volume 1, Chapter 11: Marine Mammals**), the overall sensitivity of minke whales and humpback whales to operational noise and mooring noise is considered to be **low**.

Magnitude of cumulative impact

4.3.3.3 In accordance with the Project alone assessment of operational noise and mooring noise outlined in Section 11.10.7 in **Volume 1, Chapter 11: Marine Mammals**, behavioural disturbance resulting from the Project is expected to be localised. Based on baseline data and the CEA short list, it is projected that by 2042, 29 offshore wind farms will be operational within SCANS-IV blocks CS-K, NS-E and NS-D. This includes the Project, offshore wind farms included within the CEA short list, as well as Beatrice, Inch Cape, Moray East, Moray West, Neart Na Gaoithe and Seagreen.

4.3.3.4 Whilst operational noise is likely to be to be detectable within the OAA, evidence indicates that marine mammals will continue to occupy such environments where renewable energy infrastructures are present. Marine mammals have been consistently recorded within offshore wind farm sites, including harbour porpoise, bottlenose dolphin, grey seal and harbour seal (Scheidat *et al*., 2011; Todd *et al*., 2016; Vallejo *et al*., 2017; Russell *et al.,* 2016; Clausen *et al.,* 2021; Fernandez-Betelu *et al*., 2024). While research has indicated that harbour porpoise presence locally may be reduced in the vicinity of floating WTGs, harbour porpoise were still regularly recorded within 600m of floating WTGs (Risch *et al*., 2023).

4.3.3.5 Although the footprint of operational wind farms is expected to increase as the number of operational wind farms increases, any behaviour response to noise emissions are anticipated to remain confined to the respective OAA and are unlikely to lead to the complete exclusion of marine mammals. As such, the cumulative impact is expected to affect only a small proportion of the population and is not predicted to influence population trajectories. Given the nature, frequency, and duration of potential disturbance over the operational lifetime of the Project and other developments included in the CEA, the magnitude of the cumulative effect has been assessed as **medium**.

Significance of cumulative effect

4.3.3.6 A summary of the cumulative impact magnitude, receptor sensitivity and significance of cumulative effect for marine mammal receptors are presented in **Table 4.22**

4.3.3.7 The magnitude of the cumulative impact of increased underwater noise for example, operational noise and mooring noise is deemed to be **medium**. The sensitivity is **negligible** for harbour porpoises, dolphin and seal species and **low** for minke and humpback whales. The cumulative effect of entanglement in lines and cable will, therefore, be of either **Minor** (**Not Significant**) significance for minke and humpback whales and **Negligible** (**Not Significant**) for all other marine mammal receptors, both of which are not significant in EIA terms.

Table 4.22 Significance of impact O6: disturbance from increased underwater noise for example, operational noise and mooring noise

Receptor	Magnitude	Sensitivity	Significance
Harbour porpoise	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Bottlenose dolphin	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Risso's dolphin	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Atlantic white-sided dolphin	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
White-beaked dolphin	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Short-beaked common dolphin	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Minke whale	**Medium**	**Low**	**Minor** (**Not Significant**).
Humpback whale	**Medium**	**Low**	**Minor** (**Not Significant**).
Harbour seal	**Medium**	**Negligible**	**Negligible** (**Not Significant**).
Grey seal	**Medium**	**Negligible**	**Negligible** (**Not Significant**).

4.4 Summary of cumulative effects

4.4.1.1 The results of the CEA for marine mammals is set out in **Table 4.23**, and is based on the projects and scenarios presented in **Section 4.2** and **Section 4.3**.

Table 4.23 Summary of CEA outcomes per impact for marine mammals

Potential Impact	Receptor	Sensitivity of receptor	Magnitude of effect	Significance of effect	Proposed embedded environmental measures	Residual cumulative effect
Construction cumulative effects						
Impact C5: Disturbance from increased underwater noise during pre-construction surveys	All marine mammal receptors.	**Low**	**Low**	**Negligible**	None required above existing embedded environmental measures.	**Negligible** (**Not significant**).
Impact C6: Disturbance from increased underwater noise during installation of driven piles	Harbour porpoise, Atlantic white-sided dolphin, short-beaked common dolphin, minke whale, humpback whale, grey seal and harbour seal.	**Low**	**Low**	**Negligible** (**Not significant**).	None required above existing embedded environmental measures.	**Negligible** (**Not significant**).
	Bottlenose dolphin (CES and GNS) and Risso's dolphin.		**Medium**	**Minor** (**Not significant**).		**Minor** (**Not significant**).
	White-beaked dolphin.		**High**	**Minor** (**Not significant**).		**Minor** (**Not significant**).
O&M cumulative effects						
Impact O1: EMF from cables	Harbour porpoise, bottlenose dolphin, Risso's dolphin, Atlantic white-sided dolphin, white-beaked dolphin, short-beaked common dolphin, minke whale, and humpback whale.	**Low**	**Low**	**Negligible** (**Not significant**).	None required above existing embedded environmental measures.	**Negligible** (**Not significant**).

Potential Impact	Receptor	Sensitivity of receptor	Magnitude of effect	Significance of effect	Proposed embedded environmental measures	Residual cumulative effect
	Grey seal and harbour seal.		**Negligible**			
Impact O5: Entanglement in lines and cables for example, mooring lines and array cables	All marine mammal receptors.	**Low**	**High**	**Minor** (**Not significant**).	None required above existing embedded environmental measures.	**Minor** (**Not significant**).
Impact O6: Increased underwater noise for example, operational noise and mooring noise	Harbour porpoise, bottlenose dolphin, Risso's dolphin, Atlantic white-sided dolphin, white-beaked dolphin, short-beaked common dolphin, grey seal and harbour seal.	**Medium**	**Negligible**	**Negligible** (**Not significant**).	None required above existing embedded environmental measures.	**Negligible** (**Not significant**).
	Minke whale and humpback whale.		**Low**	**Minor** (**Not significant**).		**Minor** (**Not significant**).

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6. Glossary and Abbreviations

6.1 Abbreviations

Acronym	Definition
CEA	Cumulative Effects Assessment
CES	Coastal East Scotland
CGNS	Celtic and Greater North Seas
CP	Cables and Pipelines
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
FOWF	Floating Offshore Wind Farm
GNS	Greater North Sea
GS SMA	Grey Seal Management Area
HS SMA	Harbour Seal Management Area
INTOG	Innovation and Targeted Oil and Gas
iPCoD	interim Population Consequences of Disturbance
JNCC	Joint Nature Conservation Committee
Km	Kilometres
M	Metres
MBES	Multibeam Echo Sounders
MU	Management Unit
Nm	Nautical miles
O&M	Operation and Maintenance
OAA	option agreement area
OWF	Offshore Wind Farm
PO	ScotWind Plan Option Area
SBP	Sub Bottom Profilers

Acronym	Definition
SCANS	Small Cetacean Abundance in the North Sea
SMA	Seal Management Area
SSS	Side Scan Sonar
USBL	Ultrashort Baseline
WTG	Wind Turbine Generator
ZOI	Zone of Interest

MarramWind