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Volume 8 Additional Information

Appendix 22: Marine Mammals Clarifications and Piling Re-assessment Methodology

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Acronyms and Abbreviations

CEA	Cumulative Effects Assessment
CES	Coastal East Scotland
CGNS	Celtic and Greater North Sea
CIA	Cumulative Impact Assessment
DAS	Digital Aerial Survey
EDR	Effective Deterrence Range
EIA	Environment Impact Assessment
EIAR	Environment Impact Assessment Report
ES	East Scotland
GNS	Greater North Sea
iPCoD	Interim Population Consequences of Disturbance Model
JNCC	Joint Nature Conservation Committee
km	Kilometres
MF	Moray Firth
MU	Management Unit
NC&O	North Coast and Orkney
NS	North Sea
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PTS	Permanent Threshold Shift
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals

SMU	Seal Management Unit
WTG	Wind Turbine Generator

1 Introduction

1.1.1.1 This appendix was developed to fulfil the requirements set out by NatureScot in the determination response issued on 27 March 2025, subsequent consultation on 04 June and 05 August 2025 and written feedback provided on 21 August and 03 September 2025. For clarity, the Caledonia Offshore Wind Farm (OWF) refers to the Array Area of the Proposed Development (Offshore). When referring to the Caledonia North Site and Caledonia South Site (i.e., Array Areas for Caledonia North and Caledonia South, respectively), these form part of the Caledonia OWF, which consists of up to 101 bottom-fixed and 39 floating Wind Turbine Generator (WTG) foundations in total, as well as four Offshore Substation Platforms (OSPs) on bottom-fixed foundations. Caledonia North and Caledonia South are separate projects, comprising up to 77 bottom-fixed WTG foundations and up to 39 bottom-fixed plus 39 floating WTG foundations, respectively (plus two OSPs each on bottom-fixed foundations). However, it is noted that the total WTGs of the Proposed Development (Offshore) (i.e., Caledonia North and Caledonia South combined) will not exceed 140.

1.1.1.2 In the determination response, NatureScot requested a table with densities for each species from SCANS III, SCANS IV and Digital Aerial Survey (DAS), as well as confirmation which density estimate was used for the assessment in the original Environmental Impact Assessment (EIA) submission for each species. This is provided in Section 2.

1.1.1.3 In the determination response, the main impact highlighted by NatureScot and subsequently addressed in consultation was behavioural disturbance due to piling. This impact has been re-assessed for Proposed Development (Offshore), Caledonia North and Caledonia South alone, as well as cumulatively with other projects. This appendix sets out the methodology applied in the re-assessment. Detailed Interim Population Consequences of Disturbance (iPCoD) inputs, results, and associated plots are provided for Proposed Development (Offshore), Caledonia North and Caledonia South in Appendices 23, 24, and 25, respectively. A comparison of the re-assessment results with those from the EIA is presented and discussed in Appendix 26. It should be noted that for disturbance due to piling the EIA findings for Proposed Development (Offshore), Caledonia North, and Caledonia South were consistent in terms of magnitude, sensitivity, and significance. Accordingly, Appendix 26 discusses these collectively, with results separated where necessary.

1.1.1.4 For the Proposed Development (Offshore), Caledonia North and Caledonia South alone, the re-assessment was carried out for harbour porpoise, bottlenose dolphin and minke whale using a range of different disturbance thresholds. These are discussed in Section 3.1. NatureScot requested the cumulative impact re-assessment to be carried out for harbour seal, harbour porpoise, bottlenose dolphin and minke whale, for which further information is provided in Section 3.2. Section 4 sets out the iPCoD model scenarios, including demographic parameters, followed by approach to assessing the Proposed Development (Offshore), Caledonia North and Caledonia South alone and the Cumulative Impact Assessment (CIA).

1.1.1.5 It should be noted that, in accordance with the feedback received on 21 August 2025, the re-assessment for minke whale was undertaken using dose-response, Effective Deterrence Ranges (EDRs), and deterrence function for Proposed Development (Offshore), Caledonia North and Caledonia South alone, and, consistent with the approach applied to other cetaceans, using deterrence function for the CIA re-assessment. Subsequent feedback provided on 03 September 2025 indicated that the use of deterrence functions is considered appropriate only for harbour porpoise and dolphin species. However, as the minke whale assessment had already been conducted in line with the earlier advice, it has been retained within the re-assessment documentation.

2 Determination Response Clarifications

2.1.1.1 As requested by NatureScot, Table 2-1 shows densities for each cetacean species from the SCANS III density surface (Lacey *et al*., 2022[1]), the SCANS IV block densities (Gilles *et al*., 2025[2]) and DAS (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys).

2.1.1.2 It should be noted that SCANS III and SCANS IV applied the updated abundance estimate methods (compared with SCANS II) for dolphin species and minke whale to improve corrections for undetected animals on the transect line, accounting for both availability and perception bias (Hammond *et al.*, 2021[21]). Consequently, SCANS III and SCANS IV provide absolute density estimates, which are directly comparable with DAS densities for harbour porpoise but not for bottlenose dolphin, white-beaked dolphin, common dolphin, Risso's dolphin or minke whale. It is noted that the SCANS IV density surfaces were not available at the time of drafting the EIA.

2.1.1.3 Table 2-2 provides species densities taken forward to the quantitative assessment in the EIA. In line with information presented in Section 7.5.4 of Volumes 2, 3 and 4, Chapter 7: Marine Mammals, quantitative assessment in the EIA was provided for injury and disturbance from Unexploded Ordnance (UXO) and piling. Note, for both impacts, densities used for pinnipeds were based on at-sea density maps (Carter *et al*., 2020[3]; 2022[4]). It should also be noted that the assessment for coastal population of bottlenose dolphin within the Coastal East Scotland (CES) Management Unit (MU) was not based on densities from large-scale surveys, but on densities derived from studies using local data (Quick *et al*., 2014[7]; Thompson *et al*., 2015[8]; Arso Civil *et al*., 2021a[5]; 2021b[6]; Cheney *et al*., 2024[9]). Due to a lack of data on the offshore distribution of bottlenose dolphins within the Greater North Sea (GNS) MU, a uniform distribution was assumed, resulting in a consistent density estimate of 0.003 bottlenose dolphins/km² across the entire MU (IAMMWG, 2023[10]).

Table 2-1: Summary of ranges of cetacean densities.

Species	Density (#/km^2)	Density Reference
Harbour porpoise	Grid cell specific (Caledonia OWF 0.275 - 0.345)	SCANS III density surface (Lacey *et al*., 2022[1])
	0.2813 (CS-K)	SCANS IV block density (Gilles *et al*., 2025[2])
	0.09 – 0.11	DAS
Bottlenose dolphin	Grid cell specific within the Moray Firth (max 0.0543)	Calculated (Quick *et al*., 2014[7]; Thompson *et al*., 2015[8]; Cheney *et al*., 2024[9])
	0.142 within 2km of the coast south of the Moray Firth	
	0.003 - beyond Moray Firth and 2km buffer	Calculated (IAMMWG, 2023[10])
	0.002	DAS*
White-beaked dolphin	Grid cell specific (Caledonia OWF 0.007-0.019)	SCANS III density surface (Lacey *et al*., 2022[1])
	0.1352 (CS-K)	SCANS IV block density (Gilles *et al*., 2025[2])
	0.02	DAS*
Common dolphin	Grid cell specific (Caledonia OWF 0.0002–0.0004)	SCANS III density surface (Lacey *et al*., 2022[1])
	0.01**	DAS*
Risso's dolphin	0.0376 (CS-K)	SCANS IV block density (Gilles *et al*., 2025[2])
	0.002	DAS*
Minke whale	Grid cell specific (Caledonia OWF 0.030 - 0.039)	SCANS III density surface (Lacey *et al*., 2022[1])
	0.0116 (CS-K)	SCANS IV block density (Gilles *et al*., 2025[2])
	0.003	DAS*

* DAS density for dolphin species and minke whale is relative.

** This value is based on a single sighting of 39 individuals within the Caledonia South Site. No common dolphins were observed within the Caledonia North Site plus a 4km buffer.

Table 2-2: Summary of ranges of cetacean densities used in the EIA assessment.

Species	Unexploded Ordnance (UXO)		Impact Piling	
	Injury	Disturbance	Injury	Disturbance
Harbour Porpoise	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])	Lacey *et al*. (2022[1])	Gilles *et al*. (2023[11])
Bottlenose dolphin (CES MU)	Max density from Thompson *et al*. (2015[8])		Grid cell specific density (Thompson *et al*., 2015[8]) and 2km coastal buffer (0.142 animals/km^2)	
Bottlenose dolphin (GNS MU)	N/A*	N/A*	N/A*	0.003 animals / km2 (Calculated from IAMMWG, 2023[10])
Common dolphin	Lacey *et al*. (2022[1])	Lacey *et al*. (2022[1])	Lacey *et al*. (2022[1])	Lacey *et al*. (2022[1])
White-beaked dolphin	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])	Lacey *et al*. (2022[1]) / Gilles *et al*. (2023[11])**	Gilles *et al*. (2023[11])
Risso's dolphin	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])
Minke whale	Gilles *et al*. (2023[11])	Gilles *et al*. (2023[11])	Lacey *et al*. (2022[1])	Lacey *et al*. (2022[1])

* Due to very localised impact ranges, the impact would not extend beyond the Moray Firth and therefore it is anticipated that bottlenose dolphins from the GNS MU are not at risk of experiencing Permanent Threshold Shift (PTS) from UXO clearance and piling, as well as behavioural disturbance from UXO.

** The results were the same for both densities.

3 Re-assessment Methodology

3.1 Proposed Development (Offshore), Caledonia North and Caledonia South Alone

3.1.1 Design Envelope Changes

3.1.1.1 It is important to understand that the total number of WTGs installed depends on the build scenario. The build scenarios considered are: Proposed Development (Offshore) **or** Caledonia North **or** Caledonia South, but not Caledonia North ***and*** Caledonia South. This is because the total number of WTGs across the Proposed Development (Offshore) (inclusive of Caledonia North and South) will not exceed 140. This is detailed further in Table 3-1.

3.1.1.2 Since submission of the EIA, the project engineering team has refined the maximum number of anchors per floating WTG which has in turn reduced the total number of floating WTG piling days. The number of anchors required for tension leg platform (TLP) outline design has been reduced from 18 anchors per WTG to six anchors per WTG. Consequently, the number of anchors (piled, drag embedment or others described Volume 1, Chapter 3, section 3.3.3.6.) required is now the same for both TLPs and semi-submersibles, with each requiring up to six anchors per WTG.

3.1.1.3 All revised piling scenarios now assume that four pin piles would be installed per day for bottom-fixed foundations (one full substructure jacket per day) and one anchor pile would be installed per day for floating substructures (Table 3-1). Given that semi-submersible structures assume the installation of one pile per day, compared to 1.71 piles per day for TLPs, the assumptions for the semi-submersible foundations were adopted as the worst-case temporal scenario as they would take longer to install. For comparison, number of piling days used in the EIA is provided in Table 3-2.

Table 3-1: Summary of the number of WTGs and number of piling days used in the re-assessment.

Parameter	Proposed Development (Offshore)		Caledonia North Alone	Caledonia South Alone
	Caledonia North	Caledonia South		
Number of WTGs	140 (101 bottom-fixed, 39 floating)		77 (all bottom-fixed)	78 (39 bottom-fixed, 39 floating)
	62 bottom-fixed	39 bottom-fixed, 39 floating		
Number of Offshore Substation Platforms (OSPs)	4 bottom-fixed		2 bottom-fixed	2 bottom-fixed
	2 bottom-fixed	2 bottom-fixed		
Total number of foundations	144 (105 bottom-fixed, 39 floating)		79 bottom-fixed	41 bottom-fixed, 39 floating
	6 bottom-fixed	41 bottom-fixed, 39 floating		
Number of piling days	339 days (101 days bottom-fixed WTG, 234 days floating WTG, 4 days fixed OSP)		79 days (77 days bottom-fixed WTG, 2 days bottom-fixed OSP)	275 days (39 days bottom-fixed WTG, 234 days floating WTG, 2 days bottom-fixed OSP)
	62 days bottom-fixed WTG, 2 days bottom-fixed OSP	39 days bottom-fixed WTG, 234 days floating WTG, 2 days bottom-fixed OSP		

Table 3-2: Number of piling days used in the EIA.

Parameter	Proposed Development (Offshore)		Caledonia North Alone	Caledonia South Alone
	Caledonia North	Caledonia South		
Number of piling days	515 days (101 days bottom-fixed WTG, 410 days floating WTG, 4 days bottom-fixed OSP)		79 days (77 days bottom-fixed WTG, 2 days bottom-fixed OSP)	451 days (39 days bottom-fixed WTG, 410 days floating WTG, 2 days bottom-fixed OSP)
	63 days bottom-fixed WTG, 2 days bottom-fixed OSP	38 days bottom-fixed WTG, 234 days floating WTG, 2 days bottom-fixed OSP		

3.1.2 Assessment of Disturbance

3.1.2.1 To estimate the number of harbour porpoise, bottlenose dolphins and minke whales predicted to experience behavioural disturbance as a result of piling, the assessment presented in the EIA used the porpoise dose-response function presented in Graham *et al*. (2017[12]), developed using data on harbour porpoise collected during the first six weeks of piling during Phase 1 of the Beatrice OWF monitoring program.

3.1.2.2 As a result of consultation with Paul Thompson (University of Aberdeen), SMRU Consulting and NatureScot, an interim approach to the assessment of behavioural disturbance due to piling was suggested. Details of the considerations are outlined in the *DRAFT Policy briefing on the use of behavioural-response functions within impact assessments for pile installation at offshore wind farms* document and are not discussed in detail in this appendix (this document is available upon request). It has been recommended that regulatory assessments are based upon the deterrence function derived from the Beatrice OWF monitoring data in Graham *et al*. (2019[13]) instead of the dose-response function presented in Graham *et al*. (2017[12]). As such, the numbers of animals disturbed was re-calculated using the deterrence function based on the analysis of the full Beatrice data set, as published in the peer-reviewed paper by Graham *et al*. (2019[13]). Predictions were based upon the responses to the first location piled, which is more conservative compared to probability of response based on the final location piled (Figure 3-1).

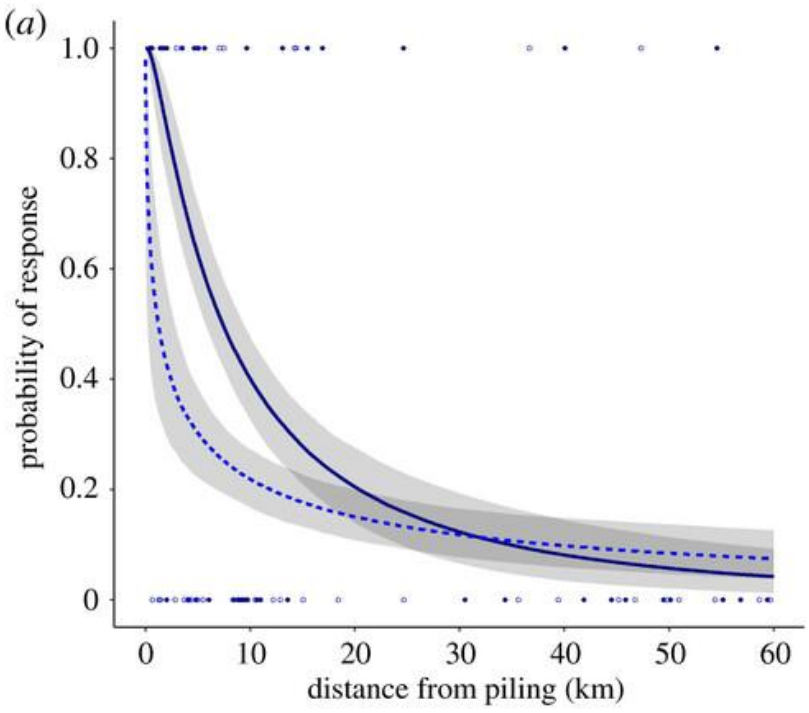

Figure 3-1: Graham *et al*. (2019) deterrence function based upon analysis of the full Beatrice construction monitoring data set (first location piled (solid navy line) and the final location piled (dashed blue line).

3.1.2.3 Additionally, in a written response provided on 21 August 2025, NatureScot requested the assessment also to be provided using the EDR approach. The EDR thresholds are area-based and, as defined by Tougaard *et al*. (2013[14]), represent the overall habitat loss that would occur if all animals vacated the area within the EDR range. The Joint Nature Conservation Committee (JNCC, 2020[15]) guidance in place during this assessment advises EDRs of 26km and 15km around the source location is used to determine the impact area from piling of monopiles and pin piles, respectively. A recent PrePARED report estimated an EDR of 9.4 km for harbour porpoise response 24-hour after piling the first two monopiles at the Moray West OWF (Benhemma-Le Gall *et al*., 2024[16]).We also note that updated JNCC guidance released in September 2025 now suggests that EDR for both monopiles and pin piles should be 20 km (JNCC, 2025[17]). Results provided here for EDR results of 15km and 26 km therefore fall either side of those that would be obtained using updated guidance.

3.1.2.4 As such, numbers of animals affected by piling were calculated using three different approaches:

- Dose-response presented in Graham *et al*. (2017[12]);
- Deterrence function based on the responses to the first location piled presented in Graham *et al*. (2019[13]); and
- 26 km, 15 km and 9.4 km EDRs.

3.1.2.5 It should be noted that the re-assessment was not carried out for all possible piling locations but the worst-case scenario locations in terms of animals affected for each species:

- Location 3 (North) and Location 7 (South) for harbour porpoise and minke whale; and
- Location 4 (North) and Location 8 (South) for bottlenose dolphin.

3.1.2.6 The worst-case for the Proposed Development (Offshore) is assumed to be the highest number of animals affected across two locations.

3.1.3 Density

3.1.3.1 In the EIA submission, the most recent site condition monitoring report was used to inform the population size of the CES MU (Cheney *et al*., 2024[9]). This report estimated the population at 245 bottlenose dolphins in 2022 (95% CI: 224–268) and this value was adopted as the most up-to-date estimate for the assessment. The estimated population size was also used to derive the density of animals applied in the assessment. Following Arso Civil *et al*. (2021b[6]) and Quick *et al*. (2014[7]), it was assumed that approximately 50% of the CES MU bottlenose dolphin population occurs within the Moray Firth at any given time. Accordingly, the probability surface for the Moray Firth was scaled to represent a density surface of 123 bottlenose dolphins (Thompson e*t al*., 2015[8]). The remaining 50% of the population was assumed to be uniformly

distributed within a 2km coastal buffer along mainland Scotland, south of the Moray Firth. In the determination response and subsequent consultation, NatureScot recommended to use the weighted mean estimate of the number of bottlenose dolphins from 2020 to 2022 of 226 (95% CI: 214-239). As such, the number of animals affected used for the dose-response in the re-assessment is different to the numbers used in the EIA.

3.1.4 Population Modelling

3.1.4.1 Due to changes in the project design envelope, NatureScot requested that the iPCoD model be run for the Proposed Development (Offshore), Caledonia North and Caledonia South alone, using the same approach as in the EIA (e.g., dose-response results presented in Graham *et al*., 2017[12]) with the updated number of piling days.

3.1.4.2 NatureScot concluded significant impacts for disturbance from piling from the iPCoD for the Proposed Development (Offshore), Caledonia North and Caledonia South alone for bottlenose dolphin within the CES MU as part of the determination response. Harbour porpoise and minke whale were not considered at risk of population-level impacts due to piling. For both harbour porpoise and minke whales, the iPCoD modelling for the Proposed Development (Offshore), Caledonia North and Caledonia South alone in the EIA using the dose-response estimates did not result in any population level impacts. The modelling with fewer piling days would result in even smaller potential population impacts compared to the values presented in the EIA. Similarly, when using the deterrence function or EDRs, the number of animals will be reduced and therefore the population level modelling will result in no effect. As such, iPCoD modelling has only been carried out for bottlenose dolphins within the CES MU, and not for harbour porpoise or minke whale. The modelling includes the updated piling scenarios with reduced number of piling days and number of bottlenose dolphins affected calculated using:

- Dose-response presented in Graham *et al*. (2017[12]);
- Deterrence function based on the responses to the first location piled presented in Graham *et al*. (2019[13]); and
- The most conservative EDR of 26km (JNCC, 2020[15]).

3.1.4.3 As requested by Nature Scot, the iPCoD for bottlenose dolphin was carried out using increasing and stable population demographic parameters, see Section 4.2 for details (Harwood and King, 2017[18]; Sinclair *et al*., 2020[19]).

3.1.5 Summary of Changes

3.1.5.1 Table 3-3 provides a summary of changes in the Proposed Development (Offshore) and Caledonia South design taken forward to the re-assessment, with respect to floating foundations.

Table 3-3: Summary of changes in the Proposed Development (Offshore) design with respect to anchors for floating foundations.

Parameter	EIA	Re-Assessment
Worst case floating WTG type	TLP	Semi-submersible
Maximum number of piled anchors per floating WTG	18 anchors/WTGs x 39 WTGs = 702 piled anchors	6 anchors/WTGs x 39 WTGs = 234 piled anchors
Number of anchors piling days	410 days assuming an average of 1.71 anchors/day	234 days assuming 1 anchors/day

3.1.5.2 Table 3-4 summarises the approach to the assessment for the Proposed Development (Offshore), Caledonia North and Caledonia South alone and harbour porpoise, bottlenose dolphin and minke whale.

Table 3-4: Summary of changes in the approach to the assessment of disturbance due to piling for the Proposed Development (Offshore), Caledonia North and Caledonia South alone.

Stage	Assessment Aspect	Species		
		Bottlenose Dolphin	Harbour Porpoise	Minke Whale
EIA	Density	Moray Firth density surface (modified from Thompson *et al.*, 2015[8]) assuming a population size of 245 (Cheney *et al.*, 2024[9])	SCANS IV block densities (Gilles *et al.*, 2023[2])	SCANS III density surface (Lacey *et al.*, 2022[1])
	Method	Dose-response (Graham *et al.*, 2017[12])		
Re-assessment	Density	Moray Firth density surface (modified from Thompson *et al.*, 2015[8]) assuming a weighted mean population size of 226 (Cheney *et al.*, 2024[9])*	SCANS IV block densities (Gilles *et al.*, 2023[2])	SCANS III density surface (Lacey *et al.*, 2022[1])
	Method	Deterrence function Graham *et al.*, 2019[13]) 9.4km, 15km and 26km EDRs (JNCC, 2020[15]; Benhemma-Le Gall *et al.*, 2024[16])		
* Note, the density outside of the 2km buffer discussed in paragraph 3.2.3.3 and applied in the cumulative impact assessment was not applied to the Proposed Development (Offshore), Caledonia North and Caledonia South alone assessment, as there would be no overlap with spatial extent of impacts				

3.2 Cumulative Re-Assessment

3.2.1 List of Projects Included

3.2.1.1 In line with advice received on 04 June 2025, the number of projects did not need to change from the EIA. As such, the list of screened-in projects remained unchanged, with the exception of the addition of one further project: the Stromar OWF. Publicly available information, including project websites and regulatory documents were utilised to find the most current information for all projects. As a result, construction timeframes for a few projects were amended (Table 3-5).

3.2.1.2 Definitions of tiers remain as presented in Table 7-55 of the Volume 2, Chapter 7: Marine Mammals:

- Tier 1 = project-specific EIA is available;
- Tier 2 = Scoping Report is available; and
- Tier 3 = Scoping Report has not yet been submitted.

3.2.1.3 The Tiers for some of the projects have been updated as they have submitted application documents (scoping or EIA) into the public domain since the CIA was conducted in the EIA:

- Bellrock, Havbredy, Talisk and Spiorad na Mara moved from Tier 3 to Tier 2 as these projects now have a Scoping Report available. Subsequently, none of the projects qualify under Tier 3.
- CENOS moved from Tier 2 to Tier 1 as it now has EIA available.

Table 3-5: List of projects and developments considered in the marine mammal CIA re-assessment for piling.

Project	Technology	Tier	2026	2027	2028	2029	2030	2031	2032	2033	2034 Onwards
Berwick Bank	Bottom-fixed	1	P	P	C	C	C	p	C	C	
Green Volt	Floating	1		P							
Ossian	Floating	1						P	P	P	P
Salamander	Floating	1			P	C					
West of Orkney	Bottom-fixed	1			P	P	P	C			
Muir Mhòr	Floating	1				P	P	P	C	C	
Cenos	Floating	1						P	P	P	
Ayre	Floating	2					C	C	C	C	
Bowdun	Floating	2				C	C	C	C	C	
Broadshore	Floating	2			C	C	C				
Buchan	Floating	2			C	C	C				
Morven	Bottom-fixed	2	C	C	C	C	C	C	C		
Sinclair	Floating	2			C	C					
Bellrock	Floating	2			C	C	C	C			
Stromar	Floating	2					C	C	C	C	
Havbredey	Floating	2							C	C	C
Talisk	Floating	2				C	C	C			
Spiorad na Mara	Bottom-fixed	2			C	C	C				
C = Construction, it has been assumed that piling can occur anytime in this timeframe; P = specifically piling activities (if known).											

3.2.2 Species-Specific Project Screening

3.2.2.1 In line with the EIA, only projects with physical overlap between the respective array areas and harbour porpoise, minke whale and seal MUs were screened into the cumulative re-assessment (Table 3-6). The only changes for the re-assessment are:

- for harbour porpoise - the addition of the West of Orkney OWF and the Stromar OWF.
- for minke whale - the addition of the Stromar OWF.
- for harbour seal - the addition of OWF within the East Scotland (ES) Seal Management Unit (SMU) and the addition of the Stromar OWF.

3.2.2.2 NatureScot shared specific instructions for project screening with respect to bottlenose dolphin and CES MU in advice dated 21 August 2025. In accordance with this advice, all projects where a 60km buffer (from the array area point closest to the CES MU) that overlapped with the CES MU were screened into the CEA.

Table 3-6: Projects screened in for assessment of each marine mammal species.

Project	Technology	Tier	Source	Harbour Porpoise (NS MU)	Bottlenose Dolphin (CES MU)	Harbour Seal (ES, NC&O, MF SMUs)	Minke Whale (CGNS MU)
Berwick Bank	Bottom-fixed	1	EIA	Yes	Yes	Yes - ES	Yes
Cenos	Floating	1	EIA	Yes	No	Yes - ES	Yes
Green Volt	Floating	1	EIA	Yes	No	Yes - ES	Yes
Ossian	Floating	1	EIA	Yes	Yes	Yes - ES	Yes
Salamander	Floating	1	EIA	Yes	Yes	Yes - ES	Yes
West of Orkney	Bottom-fixed	1	EIA	Yes	No	Yes - NC&O	Yes
Muir Mhòr	Floating	1	EIA	Yes	Yes	Yes - ES	Yes
Ayre	Floating	2	Scoping	Yes	Yes	Yes - NC&O	Yes
Bowdun	Bottom-fixed	2	Scoping	Yes	Yes	Yes - ES	Yes
Broadshore	Floating	2	Scoping	Yes	Yes	Yes - MF	Yes
Buchan	Floating	2	Scoping	Yes	Yes	Yes - NC&O	Yes
Morven	Bottom-fixed	2	Scoping	Yes	Yes	Yes - ES	Yes
Sinclair	Floating	2	Scoping	Yes	Yes	Yes - MF	Yes
Bellrock	Floating	2	Scoping	Yes	No	No*	Yes
Stromar	Floating	2	Scoping	Yes	Yes	Yes - NC&O	Yes
Havbredy	Floating	2	Scoping	No	No	No	Yes
Talisk	Floating	2	Scoping	No	No	No	Yes
Spiorad na Mara	Bottom-fixed	2	Scoping	No	No	No	Yes

* Bellrock do not overlap with grid cell at-sea density surface from Carter *et al*. (2025[23]).
NS MU = North Sea; CES MU = Coastal East Scotland MU; ES SMU = East Scotland SMU; NC&O SMU = North Coast and Orkney SMU; MF SMU = Moray Firth SMU; CGNS MU = Celtic and Greater North Sea MU.

3.2.3 Assessment Approach

Cetaceans

3.2.3.1 Sinclair (2025[20]) discussed limitations of the CIA methodology used currently in UK OWF EIAs. The CIAs vary considerably across OWF projects primarily due to differences in project-specific assessment methodology (underwater noise model, disturbance threshold, species density). There are also varying levels of data confidence, as CIAs use data from existing quantitative assessments as well as projects without quantitative assessment in the public domain.

3.2.3.2 Instead of relying on publicly available data on the number of animals impacted from EIAs or using EDRs for projects without publicly accessible EIAs, this re-assessment applied the deterrence function consistently across all OWF projects screened into the CEA. This approach promotes greater consistency across projects by avoiding variability introduced by applying different assessment methods (e.g., underwater noise model used, dose-response relationships, deterrence functions and EDRs).

3.2.3.3 In line with advice from NatureScot, the following densities were used in the re-assessment:

- Harbour porpoise – density from SCANS IV blocks (Gilles *et al*., 2023[11]), as these resulted in the highest numbers of animals affected in the EIA;
- Bottlenose dolphin – density as described for project alone in paragraph 3.1.3.1. Additionally, as requested by NatureScot, the SCANS III block R density (Hammond *et al*., 2021[21]) was applied to the area between 2km coastal buffer and the CES MU boundary, for the areas south from the Moray Firth (SCANS III was used as SCANS IV did not provide a density estimate for block R). It should be noted that this approach to the assessment results in more animals being present within the CES MU than the population size (e.g., 226 bottlenose dolphins were distributed within the Moray Firth grid cells and 2km buffer from the coast). Animals present between the 2km buffer and the boundary of the CES MU are additional to the population. As such, the assessment is considered over precautionary; and
- Minke whale - density from SCANS III modelled densities (Lacey *et al*., 2022[1]), as these resulted in the highest numbers of animals affected in the EIA.

Pinnipeds (Harbour Seal)

3.2.3.4 For harbour seals, in line with the consultation, there was no change in the approach to the assessment. The re-assessment is based on the dose-response function from Whyte *et al*. (2020[22]) as well as publicly available data from EIAs/EDR calculations.

3.2.3.5 In line with NatureScot advice, an exercise was carried out to see whether the use of the newest densities from Carter *et al*. (2025[23]) result higher number of animals affected compared to Carter *et al*. (2022[4]). The exercise was carried out for two worst-case locations – CAL04 and CAL08. This found that the Carter *et al*. (2025[23]) density surface was the most precautionary, which was therefore taken forward to the re-assessment. The number of animals affected for the Proposed Development (Offshore), Caledonia North and Caledonia South alone were also re-calculated.

4 iPCoD Scenarios

4.1 Overview

4.1.1.1 The iPCoD re-modelling for the Proposed Development (Offshore), Caledonia North and Caledonia South alone was carried out for bottlenose dolphins only. The iPCoD re-modelling for the Proposed Development (Offshore), Caledonia North and Caledonia South cumulatively with other projects was carried out for harbour porpoise, bottlenose dolphin, minke whale and harbour seal.

4.1.1.2 It should be noted that based on the consenting strategy outlined in the EIAR (see Volume 1, Chapter 5: Proposed Development Phasing), the two offshore consent applications for Caledonia North and Caledonia South are intended to allow phased development of the Proposed Development (Offshore). An EIAR covering both application areas has been prepared to fully assess the potential environmental effects across all likely delivery scenarios. The assessment provided for the Proposed Development (Offshore) (both concurrent and the sequential installation scenarios) covers the cumulative effects of Caledonia North and Caledonia South. Therefore, separate iPCoD modelling was undertaken for Caledonia North and Caledonia South individually, but not cumulatively with each other, as the combined assessment is addressed within the Proposed Development (Offshore).

4.2 Demographic Parameters

4.2.1.1 The MU specific demographic parameters used in the iPCoD modelling were obtained from Sinclair *et al*. (2020[19]) and are summarised in Table 4-1. In the EIA, the iPCoD modelling for the CES MU was carried out assuming an increasing population trajectory (Sinclair *et al*., 2020[19]). In the determination response, NatureScot requested modelling to also be carried out assuming a stable population and therefore iPCoD modelling has been carried out for both, stable and increasing CES MU populations.

Table 4-1: Demographic parameters used in the iPCoD modelling from Sinclair *et al*. (2020) and Harwood and King (2017).

Parameters	Harbour Porpoise	Bottlenose Dolphin		Minke Whale	Harbour Seal*		
MU Name	NS	CES (increasing)	CES (stable)	CGNS	MF	NC&O	ES
MU Abundance	346,601	226	226	20,118	1,365	1,951	383
UK MU Abundance	159,632	N/A	N/A	10,288	N/A	N/A	N/A
Calf/pup survival	0.8455	0.925	0.86	0.7	0.4	0.24	0.4
Juvenile survival	0.85	0.962	0.94	0.77	0.78	0.86	0.78
Adult survival	0.925	0.98	0.94	0.96	0.92	0.8	0.92
Fertility	0.34	0.24	0.25	0.91	0.85	0.9	0.85
Age at independence	1	3	2	1	1	1	1
Age at first birth	5	9	9	9	4	4	4
* It should be noted that the size of the seal monitoring units used in the iPCoD has changed compared to the EIA. This is because, in line with advice from NatureScot, updated Carter *et al*. (2025[23]) at-sea density were used and these are aligned with SMU size values presented in SCOS (2025[24]), rather than SCOS (2023[25]) used in the EIA.							

4.3 Proposed Development (Offshore), Caledonia North and Caledonia South Alone

4.3.1 Species

4.3.1.1 As discussed in paragraph 3.1.4.2 *et seq*, the iPCoD modelling for the Project alone is provided for bottlenose dolphins only, using a total population size of 226 dolphins (weighted mean estimate from 2020 to 2022) (Cheney *et al*., 2024[9]).

4.3.1.2 The assessment provided in Volumes 2, 3 and 4, Chapter 7: Marine Mammals showed that there is no residual risk of injury to bottlenose dolphin as a result of underwater noise during piling. Therefore, across all iPCoD scenarios it was assumed that zero animals will experience auditory injury (PTS). Given that the iPCoD assessment is based on the worst-case temporal scenario, the number of animals disturbed by each OWF was based on single piling to ensure the maximum duration of overall installation period.

4.3.2 Proposed Development (Offshore)

4.3.2.1 Three scenarios were considered for the installation of the Proposed Development (Offshore) and are described in Table 4-2. The worst-case temporal scenario was taken forward to the assessment in line with the assumptions in the original EIA application. The updated number of piling days was considered in line with the assumptions discussed in paragraph 3.1.1.1 *et seq.* Since the iPCoD scenarios aim to represent the worst-case temporal scenario, the modelling assumed no simultaneous piling activities within the Caledonia OWF at any given time, ensuring the maximum possible installation duration is assessed. The sequential installation scenario of the Proposed Development (Offshore) assumes that Caledonia North and Caledonia South will be installed sequentially (in either order) with either no gap or up to a five year gap between the completion of installation at the North and the commencement of installation in the South (Table 4-2). It should be noted that the iPCoD model is not sensitive to the sequence of installation (e.g., whether Caledonia North is installed first or Caledonia South); therefore, the assumption was made that Caledonia North is going to be installed first.

4.3.2.2 It should be noted that, the Proposed Development (Offshore) would comprise a total of 105 bottom-fixed WTG foundations (WTGs and OSPs), which is fewer than the combined total of Caledonia North and Caledonia South, if only one of these were to be consented (79 + 41 = 120; Table 3-1). The build scenarios are therefore: Proposed Development (Offshore) or Caledonia North or Caledonia South, but not Caledonia North and Caledonia South. Given the proximity of Caledonia South to the CES MU, an area sensitive to bottlenose dolphins, a precautionary worst-case scenario was adopted. Under this assumption, a sequential installation of the Proposed Development (Offshore) would result in a higher number of bottom-fixed turbines being installed within the Caledonia South Site (41; see Table 4-2) and fewer within the Caledonia North Site (64).

Table 4-2: Scenario descriptions for the concurrent and sequential installation of foundations in the Proposed Development (Offshore) (these scenarios were modelled in the iPCoD modelling).

Scenario	Gap Between Installation at Caledonia North Site and Caledonia South Site	Scenario Description
Concurrent installation	N/A	Installation of up to 105 bottom-fixed foundations (WTGs and OSPs) across the Caledonia North Site and Caledonia South Site as well as 39 floating WTG foundations in the Caledonia South Site within the same timeframe, resulting in a total of 339 piling days between October 2028 and August 2030, inclusive.
Sequential installation	No gap	The first phase of installation of 64 bottom-fixed jacket foundations at the Caledonia North Site between October 2028 and February 2030 (64 piling days). There would be no gap (e.g., the second phase of installation of 41 bottom-fixed jacket foundations and 39 floating foundations at the Caledonia South Site will take place between March 2030 to January 2032 (275 piling days).
	Five-year gap	The first phase of installation of 64 bottom-fixed jacket foundations at the Caledonia North Site between October 2028 and February 2030 (64 piling days). A maximum of five year gap would then occur. The second phase of installation of 41 bottom-fixed jacket foundations and 39 floating foundations at the Caledonia South Site between March 2035 to January 2037 (275 piling days).

4.3.3 Caledonia North

4.3.3.1 The worst-case temporal scenario was taken forward to the assessment in line with the assumptions in the original EIA application. There was no update for the iPCoD scenario as changes of the number of piling days discussed in paragraph 3.1.1.1 *et seq* refer to floating foundations only.

4.3.3.2 The scenario assumes installation of jackets in Caledonia North with four pin piles installed per day (one full substructure jacket per day), resulting in 79 piling days (77 for WTGs and two for OSPs) between October 2028 and February 2030, inclusive.

4.3.4 Caledonia South

4.3.4.1 The worst-case temporal scenario was taken forward to the assessment in line with the assumptions in the original EIA application. The updated number of piling days was considered in line with assumptions discussed in paragraph 3.1.1.1 *et seq*.

4.3.4.2 The worst-case temporal scenario was taken forward to the assessment in line with the assumptions in the original EIA application. The scenario assumes installation of a mix of bottom-fixed and floating foundations in Caledonia South with four pin piles installed per day for bottom-fixed substructures (one full substructure jacket per day) and one anchor pile is installed per day for floating substructures. The total piling duration is 275 days between October 2028 and September 2030 and accounts for 41 days for bottom-fixed jackets (39 WTGs and two OSPs) and 234 days for anchors (39 floating WTGs with six anchors per WTG).

4.4 Cumulative Re-assessment

4.4.1 Proposed Development (Offshore), Caledonia North and Caledonia South Alone Scenarios

4.4.1.1 The projects included in the cumulative iPCoD in the re-assessment per species are the same as presented in Table 3-6.

4.4.1.2 Two scenarios were taken forward for the assessment of cumulative effects and iPCoD modelling, concurrent and sequential (assuming no gap between installation at Caledonia North and Caledonia South) installation scenarios. Sequential installation scenario with no gap was selected as it overlaps with the higher number of projects screened into the CIA (compared to the scenario with a maximum gap of up to five years) and therefore represents the worst-case scenario in terms cumulative number of animals affected. The duration of both scenarios is as follows:

- Concurrent installation scenario – 2028 to 2030; and
- Sequential installation scenario (no gap) – 2028 to 2032.

4.4.1.3 For Caledonia North and Caledonia South, the scenarios taken forward to the iPCoD modelling are the same as presented in paragraph 4.3.3.1 *et seq*.

4.4.2 Project-specific Piling Days

4.4.2.1 For projects with indicative piling schedules available in the public domain (Berwick Bank, Ossian, Salamander, West of Orkney) these were used in the modelling.

4.4.2.2 There are a number of projects at early stage of development without EIA documents available in the public domain, beyond the scoping report. However, all projects taken forward to the cumulative iPCoD modelling have information about the anticipated number of foundations (WTGs and OSPs) and/or number of piles to be installed available in the public domain. For these projects, the number of piling days was assessed based on the number of piles to be installed and the assumption that there will be up to two piles installed per day (Table 4-3). The number of piling days was evenly distributed throughout the construction years.

4.4.3 Number of Animals Impacted and Reference Populations

4.4.3.1 For the Proposed Development (Offshore), Caledonia North and Caledonia South, the assumptions regarding the number of animals are the same as discussed in paragraph 3.1.2.1.

4.4.3.2 The MU specific demographic parameters used in the iPCoD modelling are discussed in Section 4.2.

4.4.3.3 For the projects listed in Table 3-6 and scoped into the assessment, the number of animals predicted to be disturbed were based on:

- Deterrence function for harbour porpoise, bottlenose dolphin and minke whale (see paragraph 3.2.3.1 *et seq.*); and
- The project-specific values presented in respective EIARs or calculated based on the EDRs and Carter *et al*. (2025[23]) densities for seals (see paragraph 3.2.3.4 *et seq.*).

4.4.3.4 The numbers of animals affected used in the iPCoD modelling are presented for the Proposed Development (Offshore), Caledonia North and Caledonia South in Volume 8, Appendices 23, 24 and 25, respectively.

Table 4-3: Projects screened into the cumulative iPCoD.

Project	Predicted Number of Piled Foundations	Maximum Number of Piles	Total Number of Piling Days
Projects with EIAs available in the public domain			
Berwick Bank	179 WTGs 8 OSPs	1,432 (WTG) 64 (OSP)	372
Ossian	265 WTGs 15 OSPs	1,590 (WTG) 216 (OSP)	602
Salamander	7 WTGs	80	80
West of Orkney	125 WTGs 5 OSPs	580	290
Cenos	95 WTGs 2 OSPs	1,710 (WTG) 24 (OSP)	293
Muir Mhor	67 WTGs 2 OSPs	603 (WTG) 12 (OSP)	175
Green Volt	1 OSP	4	4
Projects without piling-specific data available in the public domain			
Ayre	67 WTGs	699	350*
Bellrock	80 WTGs	960	480*
Broadshore	60 WTGs	720	360*
Buchan	70 WTGs	702	351*
Morven	191 WTGs	2,556	1,278*
Sinclair	6 WTGs	72	36*
Stromar	71 WTGs	924	462*
Havbredey	110 WTGs	990	495*
Talisk	33 WTGs	297	149*
Spiorad na Mara	66 WTGs	528	264*
* For projects without EIAs in public domain, the assessed assumed two piles installed per piling day.			

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