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Volume 7 Standalone Appendices

Appendix 13 Caledonia North Draft Marine Mammal Mitigation Protocol

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Acronyms and Abbreviations

ADD	Acoustic Deterrent Device
BEIS	Department for Business Energy and Industrial Strategy
EIAR	Environmental Impact Assessment Report
EPS	European Protected Species
HF	High Frequency
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
MD-LOT	Marine Directorate – Licensing Operations Team
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observer
MNR	Marine Noise Registry
OECC	Offshore Export Cable Corridor
OSP	Offshore Substation Platform
PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivores in Water
PTS	Permanent Threshold Shift (auditory injury)
SBP	Sub-bottom Profiler
UHRS	Ultra-high Resolution Sparker
USBL	Ultra-short Baseline Seismic Survey
UXO	Unexploded Ordnance
VHF	Very High Frequency
WTG	Wind Turbine Generator

Executive Summary

The objective of this draft Marine Mammal Mitigation Protocol (MMMP), prepared specifically in relation to Caledonia North, is to outline the recommended procedure for mitigating the risk of auditory injury to marine mammals that are within proximity to geophysical surveys, unexploded ordnance (UXO) clearance and piling operations. The draft MMMP shall provide a framework for the final MMMP, which is anticipated to be required under conditions of the planning consent. This is to ensure appropriate controls are in place to manage environmental risks associated with the construction of the offshore components of Caledonia North as assessed in the Environmental Impact Assessment Report.

As per the Joint Nature Conservation Committee (2017) guidance for geophysical surveys, a Marine Mammal Observer (MMO) will conduct a pre-shooting search for 30 minutes of the mitigation zone, which will be defined post-consent when equipment details are available. Given the small impact ranges predicted for unexploded ordnance (UXO) clearance by low-order deflagration (maximum 990m), a 30-minute pre-clearance visual search covering a 1km radius is suggested to be conducted by two MMOs. Given the small impact ranges predicted for instantaneous Permanent Threshold Shift (PTS) from piling (maximum 840m), an 11-minute Acoustic Deterrent Device (ADD) activation period is suggested to be used to deter marine mammals from the injury zone prior to the commencement of impact piling. No visual or acoustic monitoring is required in addition to the ADD activation period as this is considered sufficient to deter marine mammals from the maximum instantaneous PTS impact range.

The indicative mitigation measures presented in this draft MMMP are based on current guidance and will be refined post-consent at the stage of the Piling Strategy (piling) and Marine Licence application process (UXO clearance and geophysical surveys), as well as anticipated European Protected Species Licences, once relevant project parameters have been refined.

1 Introduction

1.1 Purpose of this Document

1.1.1.1 This document presents the draft MMMP to support the Environmental Impact Assessment Report (EIAR) for Caledonia North. The purpose of this draft MMMP is to provide a framework for the final MMMP, which is anticipated to be required under conditions of the planning consent, to ensure appropriate controls are in place to manage environmental risks associated with the construction of Caledonia North as assessed in the EIAR.

1.2 Caledonia North

1.2.1.1 Caledonia North comprises the Caledonia North Site (Array Area) and the Caledonia North Offshore Export Cable Corridor (OECC) located in the Moray Firth, Scotland. The key components and infrastructure of Caledonia North are as follows:

- Up to 77 Wind Turbine Generators (WTGs) located within the Caledonia North Site;
- Up to two Offshore Substation Platforms (OSPs);
- Inter-array cables which connect the WTGs to the OSPs;
- An interconnector cable which connects the two OSPs together; and
- Up to two offshore export cables located within the Caledonia North OECC between the OSPs and Landfall Site at Stake Ness, Aberdeenshire.

1.3 Overview

1.3.1.1 This draft MMMP summarises the realistic worst-case scenarios considered in the EIAR from geophysical surveys, UXO clearance and piling operations. It has been developed to recommend measures for mitigating the potential impact of auditory injury, specifically PTS, on marine mammals during construction at Caledonia North. These mitigation measures are based on the results provided in the following supporting studies:

- Volume 3, Chapter 7: Marine Mammals;
- Volume 7B, Appendix 7-3: Piling Results (Auditory Injury and Disturbance); and
- Volume 7, Appendix 6: Underwater Noise Assessment.

1.3.1.3 It should be noted that this draft MMMP includes a set of indicative mitigation measures based on current guidance and will be reviewed post-consent at the stage of the Piling Strategy for piling activities, the Marine Licencing process for UXO clearance and geophysical surveys, as well as any anticipated European Protected Species (EPS) Licence applications, once relevant project parameters have been refined. These finalised documents will include updates to the impact assessment as presented in the EIAR, as necessary, and be supported by updated MMMPs which incorporates the most recent guidance at that time. The final MMMPs, required as a condition of consent for the Section 36 Consent and Marine Licences, will be submitted to Marine Directorate – Licensing Operations Team (MD-LOT) for approval post-consent.

2 Geophysical Surveys

2.1 Overview

2.1.1.1 The set of indicative measures set out below has been prepared to support the current application, in addition to any future anticipated EPS Licence application, for the mitigation of geophysical survey operations within Caledonia North.

2.1.1.2 A series of pre-construction surveys will be undertaken within the Caledonia North Site and Caledonia North OECC. Geophysical surveys are non-intrusive and will utilise towed equipment such as side-scan sonar, sub-bottom profiler (SBP), multibeam echosounder, ultra-short baseline seismic survey (USBL), ultra-high resolution sparker (UHRS) and magnetometer to gather detailed information on the bathymetry, seabed sediments, geology and anthropogenic features (e.g., existing seabed infrastructure, UXO) that exist across Caledonia North.

2.1.1.3 The indicative geophysical survey mitigation presented in Section 2.3 follows the guidance provided in Joint Nature Conservation Committee (JNCC, 2017[1]): JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys.

2.2 Summary of Impacts

2.2.1.1 The assessment of impacts provided in Volume 3, Chapter 7: Marine Mammals of the EIAR showed that across all geophysical equipment considered to be used at Caledonia North, as listed in paragraph 2.1.1.2, only SBPs and UHRS have indicated potential risks of injury to marine mammals (Table 2–1). As such, only SBP and UHRS require mitigation and are thus considered further.

Table 2–1: Summary of the auditory injury (PTS) impact ranges from SBP and URHS.

Equipment	Summary of potential injury impact
SBP	Dolphins: No risk of injury. Porpoise: The Department for Business Energy and Industrial Strategy (BEIS, 2020[2]) has indicated that PTS onset is likely to occur within 23m from the use of this equipment at source levels of 267 dB re 1 µPa (SPL_{peak}). Minke whale: Within 5m of the source when SBP pingers operate with a sound source of 220 dB re 1 µPa (SPL_{peak}) (Shell, 2017[3]). Seals: Approximately 10m (BEIS, 2019a[4]). Albeit with a high degree of uncertainty, BEIS (2019b[5]) suggested that SBPs used in high-resolution geophysical surveys have a very low potential for injury.
UHRS	Highly focused beam with limited horizontal transmission of noise with an expected source level of 200 – 226 dB re 1 µPa and frequency of 100Hz to 5kHz (average approx. 1.5kHz) (Hartley Anderson Ltd, 2020[6]). The source levels of UHRS equipment are below the PTS-onset thresholds for dolphin species. For harbour porpoise, minke whale, humpback whale and seals, the predicted UHRS source levels exceed the PTS-onset threshold and as such, the use of this equipment has the potential to cause PTS. The extent of the impact is expected to be similar to that of SBP.

2.3 Mitigation Methods

2.3.1.1 As per the JNCC (2017[1]) guidance, a standard mitigation zone of 500m radius is advised for high resolution surveys (UHRS seismic such as a mini airgun or sparker, or electromagnetic SBP sources). However, given that evidence suggests much smaller injury ranges (Table 2–1), the extent of the mitigation zone for SBP and UHRS will be defined post-consent when equipment details are available. A 30-minute pre-shooting Marine Mammal Observer (MMO) watch of the mitigation zone should be carried out. JNCC (2017[1]) advises that a pre-shooting Passive Acoustic Monitoring (PAM) watch should be used when visual observations by an MMO are not possible.

2.3.1.2 If a marine mammal is detected in the mitigation zone during the pre-shooting watch, the soft-start will be delayed until animals are outside of the mitigation zone or by a minimum of 20 minutes after the last detection within the mitigation zone.

2.3.1.3 Where possible, a soft-start will be used over at least 15 minutes (and no more than 25 minutes) before full operational power is used.

2.3.1.4 If there is a pause in operations longer than 10 minutes, then a pre-shooting watch and soft-start will be required before recommencing.

2.3.1.5 The implementation of the mitigation measures outlined shall ensure that potential risk of injury from geophysical surveys to marine mammals is minimised. These measures will be reviewed and confirmed post-consent once the scope of geophysical surveys is known.

2.4 Reporting

2.4.1.1 The mitigation report will be submitted to MD-LOT. The content of the mitigation report will be agreed with MD-LOT post-consent.

2.4.1.2 Other reporting will be conducted in accordance with the requirements and conditions specified in the Marine Licence or EPS Licence, which will be determined post-consent. For example, this includes the submission of a close-out report via the UK Marine Noise Registry (MNR; JNCC, 2024[7]).

3 Unexploded Ordnance (UXO)

3.1 Overview

3.1.1.1 The set of indicative measures set out below has been prepared to support this application, in addition to the future Marine Licence and anticipated EPS Licence application, for the mitigation of UXO clearance operations within Caledonia North.

3.1.1.2 Once the location of any UXOs within the Caledonia North Site and Caledonia North OECC has been confirmed, a risk assessment will be undertaken and items of UXO will either be avoided by equipment micro-siting, moved, or disposed of *in situ*. As the detailed pre-construction surveys have not yet been completed, it is not possible at this time to determine how many items of UXO will require clearance. As a result, a separate Marine Licence will be applied for post-consent for the clearance (where required) of any UXO identified.

3.1.1.3 In line with the advice received in the Scoping Opinion (Volume 7, Appendix 3), alternatives to high-order detonations have been considered alongside the effectiveness of these techniques. The UXOs found within the Moray West Offshore Wind Farm (OWF) were cleared using a low-order deflagration technique, with 100% success rate (Ocean Winds, 2024[8]). As such, given the evidence that low-order deflagration is a viable and effective method to be applied during UXO clearance at the Caledonia North Site and Caledonia North OECC, the potential effects of high-order detonation have not been considered further. Should alternative methods to low-order deflagration of UXO clearance (which offer similar or lower levels of noise reduction) become available at the time of authoring the final MMMP (post-consent stage), these may also be considered.

3.1.1.4 The indicative UXO clearance mitigation presented in Section 3.3 follows the guidance provided in JNCC (2023[9]): Draft guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment.

3.2 Summary of Impacts

3.2.1.1 Potential impacts from a low-order clearance has been modelled and assessed in Volume 3, Chapter 7: Marine Mammals, assuming a donor charge of 0.25kg. Underwater noise from the UXO clearance is defined as a single pulse and, thus, both the weighted SEL_{cum} criteria and the unweighted SPL_{peak} criteria from Southall *et al*. (2019[10]) have been presented and animal fleeing assumptions do not apply. Full details of the underwater noise modelling and the resulting auditory injury (PTS-onset) impact areas and ranges are detailed in Volume 7, Appendix 6: Underwater Noise Assessment.

3.2.1.2 The auditory injury (PTS-onset) range for low-order clearance is small across all species and both metrics (SPL_{peak} and SEL_{cum}), with a maximum impact range of 0.99km (Table 3–1).

Table 3–1: Summary of the auditory injury (PTS) impact ranges for UXO clearance using the impulsive, weighted SEL_{cum} and unweighted SPL_{peak} noise criteria from Southall *et al*. (2019[10]).

Hearing Group	Species	PTS Unweighted SPL_{peak} Impact Range (m)	PTS Weighted SEL_{cum} Impact Range (m)
Very High Frequency (VHF) Cetacean	Harbour porpoise	990	80
High Frequency (HF) Cetacean	Dolphins (bottlenose, white-beaked, common and Rosso's dolphins)	60	<50
Low Frequency (LF) Cetacean	Minke and humpback whale	170	230
Phocid Carnivores in Water (PCW)	Seals (harbour and grey seals)	190	<50

3.3 Mitigation methods

3.3.1.1 As per the JNCC (2023[9]) draft guidance, a 30-minute pre-clearance visual search covering a 1km radius will be conducted by two MMOs. The maximum PTS impact range predicted from UXO clearance by low-order deflagration (0.25kg charge weight, Table 3–1) is 990m and, therefore, the minimum required mitigation zone of 1km is considered sufficient. The MMOs will be provided with the JNCC guidelines and the recording forms (deck forms) to record details of all marine mammal detections and mitigation undertaken.

3.3.1.2 If a marine mammal is detected within the 1km mitigation zone, the UXO clearance operations will be delayed until the animal(s) has moved out of the mitigation zone, or delayed by 20 minutes from the time of the last observation/detection if it cannot be confirmed than the animal(s) has left the mitigation zone.

3.3.1.3 The MMOs will continue visual monitoring of the mitigation zone during the UXO clearance operations and for at least 15 minutes after the UXO clearance by low order deflagration, to record any evidence of injury to marine life, including fish kills.

3.3.1.4 In line with JNCC (2023[9]) draft guidance, since the modelled auditory injury zone is less than 1km for low-order deflagration, the use of acoustic deterrents and noise abatement is not considered necessary. However, should the Applicant consider the pre-UXO clearance deployment of Acoustic Deterrent Devices (ADDs), the following measures are likely to be implemented:

- A suitably trained ADD operator and a dedicated MMO would implement the mitigation set out in the final UXO MMMP. The MMO will be required to undertake the pre-clearance watch, which is proposed to be 30 minutes (or 60 minutes depending on water depth) in accordance with current draft guidance (JNCC, 2023[9]).
- The duration of ADD deployment would be calculated using swimming speed assumptions to ensure that marine mammals are beyond the mitigation zone when UXO clearance commences.
- The ADD would be switched off immediately prior to UXO clearance.

3.3.1.5 These measures will be reviewed and confirmed post-consent once the scope of UXO clearance is known.

3.4 Reporting

3.4.1.1 The mitigation report will be submitted to MD-LOT. The content of the mitigation report will be agreed with MD-LOT post-consent.

3.4.1.2 Other reporting will be conducted in accordance with the requirements and conditions specified in the Marine Licence or EPS Licence, which will be determined post-consent (e.g., the submission of a close-out report via the UK MNR; JNCC, 2024[7]).

4 Piling

4.1 Overview

4.1.1.1 The set of indicative measures set out below has been prepared to support the current application, in addition to the future anticipated Piling Strategy and anticipated EPS Licence application, for the mitigation of piling operations within the Caledonia North.

4.2 Scenarios Considered

4.2.1.1 Underwater noise modelling (see Volume 7, Appendix 6) was undertaken to inform analysis of the impacts of the underwater piling noise on marine mammals for two foundation design types:

- A monopile foundation scenario for bottom-fixed WTGs, installing a 14m diameter pile with a maximum blow energy of 6,600 kJ, with up to two monopile foundations installed within a 24-hour period (Table 4–1); and
- A multi-leg jacket foundation scenario for bottom-fixed WTGs, installing a 4m diameter pile with a maximum blow energy of 4,400 kJ, with up to four multi-leg foundations installed within a 24-hour period (Table 4–2).

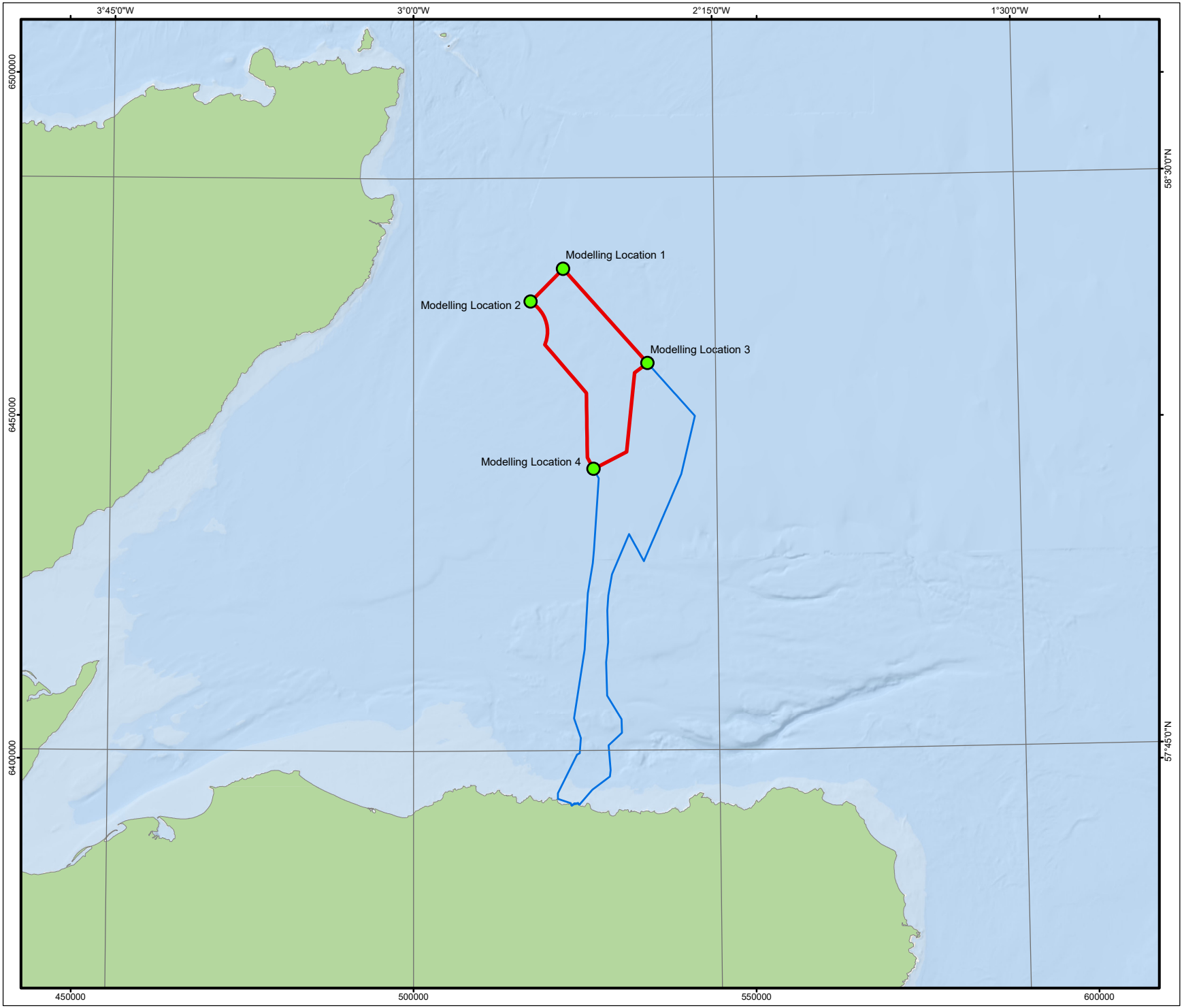
4.2.1.2 Figure 4-1 denotes the underwater noise modelling locations used and details which foundation type was applicable at each modelling location. Full details of the underwater noise modelling and the resulting auditory injury (PTS-onset) impact areas and ranges are detailed in Volume 7, Appendix 6: Underwater Noise Assessment. It should be noted that the durations presented in Table 4–1 and Table 4–2 are illustrative for the purposes of modelling but would be subject to variation based on a number of factors including ground conditions at a given location.

Table 4–1: Summary of the soft start and ramp up scenario used for the monopile foundation modelling.

Monopile Foundation	10% (660 kJ)		20% (1,320 kJ)	40% (2,640 kJ)	60% (3,960 kJ)	80% (5,280 kJ)	100% (6,600 kJ)
No of strikes	6	570	300	300	300	300	1,724
Duration	1 min	19 mins	10 mins	10 mins	10 mins	10 mins	57 mins, 28 sec
Strike rate (bl/min)	6	30	30	30	30	30	30
Per pile: 3,500 strikes over 1 hour, 57 minutes, 28 seconds. Two piles: 7,000 strikes over 3 hours, 54 minutes, 56 seconds.							

Table 4–2: Summary of the soft start and ramp up scenario used for the multi-leg foundation modelling.

Jacket Foundation	10% (440 kJ)		20% (880 kJ)	40% (1,760 kJ)	60% (2,640 kJ)	80% (3,520 kJ)	100% (4,400 kJ)
No of strikes	6	570	300	300	300	300	1,724
Duration	1 min	19 mins	10 mins	10 mins	10 mins	10 mins	57 mins, 28 sec
Strike rate (bl/min)	6	30	30	30	30	30	30
Per pile: 3,500 strikes over 1 hour, 57 minutes, 28 seconds. Four piles: 14,000 strikes over 7 hours, 49 minutes, 52 seconds.							

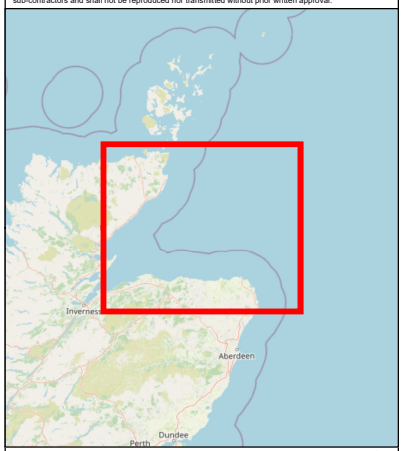


Caledonia North Site

Caledonia North Offshore Export Cable Corridor

Modelling location type

Fixed Foundation



0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	24/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO	CONTRACTOR REV
UKCAL1_GO_WNF_MMM_MAP_00459	01

GEODETIC PARAMETERS
WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

Figure 4-1: Representative Piling Locations Used in the Underwater Noise Modelling

STATUS	SCALE	
Approved	1:750,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

4.3 Summary of Impacts

4.3.1.1 NatureScot has communicated that the modelling of cumulative PTS-onset impact ranges (using the SEL_{cum} metric) is based on highly conservative assumptions that could lead to an over-estimation of impact zones (see Volume 3, Chapter 7: Marine Mammals for detailed consultation). Cumulative PTS is, therefore, not expected to be mitigated and the following sections will only address mitigation measures for instantaneous PTS.

4.3.1.2 The maximum instantaneous PTS-onset range from piling was 840m for VHF cetaceans (harbour porpoise) and less than 60m for all other species groups (Table 4–3).

Table 4–3: Summary of the worst-case piling underwater noise modelling results for injury (instantaneous PTS) of marine mammals.

Hearing Group	Species	Instantaneous PTS-onset Range (SPL_{peak}) (m)
VHF	Harbour porpoise	840
HF	Dolphins (bottlenose, white-beaked, common, Risso's dolphins)	<50
LF	Minke & humpback whale	50
PCW	Seals (harbour and grey seals)	60

4.4 Vibropiling

4.4.1.1 The suitability of the use of vibropiling for Caledonia North will be assessed as the project design evolves and will be confirmed in the Piling Strategy and final MMMP.

4.4.1.2 While there is a paucity of data on responses of cetaceans to vibropiling, Graham *et al*. (2017[11]) studied the behavioural responses of bottlenose dolphins and harbour porpoises to both impact and vibropiling noise in Scotland. There was a significant reduction in acoustic detections of bottlenose dolphins and harbour porpoises in the vicinity of construction during vibropiling. While displacement cannot be directly assumed from decreased detections, these results provide some evidence that vibropiling might result in the displacement of individuals in the vicinity of construction.

4.4.1.3 It is anticipated that it could take an average of 3.5 hours to change between vibro-hammer and impact-hammer during a piling installation sequence, and that once the impact hammer is in place, impact piling

would commence with a soft-start period before increasing hammer energy. Therefore, it is expected that vibropiling prior to impact piling would act as an initial deterrence effect in the same way that ADDs do prior to the soft-start of impact piling. As a result, piling operations will transition from vibropiling to impact piling without the requirement for ADD mitigation before the impact piling soft-start (unless there is a significant gap of >6 hours between vibro- and impact-piling). This approach was also agreed for the Moray West OWF project.

4.5 Mitigation Methods

4.5.1 Overview

4.5.1.1 The current guidance on minimising the risk of injury to marine mammals from piling noise (JNCC, 2010[12]) does not take into consideration the advancement in our understanding of the effects of noise on marine mammals, and increased evidence that ADDs are effective at deterring marine mammals from the instantaneous PTS mitigation zone.

4.5.1.2 This draft MMMP recommends that the most suitable pre-piling mitigation method is the use of ADDs, following the rationale and approach used at the adjacent Beatrice, Moray East and Moray West OWFs, where the efficacy of this method has been demonstrated.

4.5.2 Acoustic Deterrent Devices (ADDs)

4.5.2.1 The Lofitech seal scarer device has been demonstrated to have consistent effective deterrent ranges for marine mammals and has proven effective in deterring animals beyond the maximum instantaneous PTS-onset impact range of 840m (Brandt *et al*., 2013a[13]; 2013b[14]; Gordon *et al*., 2015[15]; McGarry *et al*., 2017[16]; Rose *et al*., 2019[17]; Boisseau, *et al*., 2021[18]; Graham *et al*., 2023[19]). The use of this ADD has proven effective for marine mammal mitigation during piling activities at the adjacent Beatrice OWF (Thompson *et al*., 2020[20]) and Moray East OWF (Graham *et al*., 2023[19]). However, it is acknowledged that ADD development is an active field, and that an alternative device may be selected when the MMMP is finalised. For example, the Lofitech seal scarer has been shown to cause deterrence to harbour porpoise to multiple kilometres (e.g., Brandt *et al*., 2013b[14]; Thompson *et al*., 2020[20]) – distances which exceed the maximum instantaneous PTS -onset impact ranges currently predicted for pile-driving at the Caledonia North Site. For deterrence of up to 1km, it is possible that alternative devices may be sufficient (e.g., Voß *et al*., 2023[21]), albeit with careful consideration given to minimising the potential for excessive deterrence with the need for reliable deterrence within the PTS-onset impact range.

4.5.3 ADD Deployment and Operation

4.5.3.1 Trained ADD personnel should be established that will be responsible for operation, monitoring and reporting of the device. Prior to the commencement of piling, the main device and a back-up device should be tested to ensure that they are working (i.e., by using a hydrophone system and computer interface with appropriate software).

4.5.3.2 The ADD should be activated prior to the commencement of the soft-start procedure. The duration of ADD activation should allow for the animal to move beyond the potential injury zone. It is vital that the duration of the ADD is sufficient to ensure marine mammals are deterred from the injury zone, while minimising the potential for unnecessary far-field disturbance impacts (Graham *et al*., 2019[22]). Therefore, the ADD deployment duration should not exceed the time required for animals to flee the injury zone at maximum hammer energy. Harbour porpoises have the largest maximum instantaneous PTS-onset range at full hammer energy (840m). Assuming a slow swim speed of 1.4ms^{-1}, a porpoise starting at the pile location and moving away in response to piling noise would take 10.1 minutes to be beyond the instantaneous PTS-onset range. For other marine mammal species, the minimum time would be less than 1 minute. The duration of ADD activation is, therefore, recommended to be 11 minutes to ensure the minimum time needed to deter the animals beyond the PTS-onset impact zone is met whilst minimising any additional ADD activation time which could result in unnecessary far-field auditory disturbance.

4.5.3.3 The approach outlined above is considered precautionary in terms of mitigating injury due to piling commencing at a lower hammer energy, and the likelihood that animals will be displaced to some extent from the vicinity of piling prior to ADD activation due to vessel activity (Rose *et al*., 2019[17]; Benhemma-Le Gall *et al*., 2023[23]). It is important to balance the risk of injury with the extent of disturbance, and it is noted that ADD durations in the final MMMP will be influenced by both predicted injury ranges and the latest evidence of animals disturbance around piling operations.

4.5.3.4 Should the project ultimately select an ADD for which the evidence suggests deterrence from extended use to occur to distances not much larger than the predicted instantaneous PTS-onset range (see Section 4.5.2), then consideration may be given for a longer duration of ADD activation.

4.5.5 Soft-Start and Ramp Up Procedure

4.5.5.1 Following vibropiling or ADD deployment, a softstart procedure will commence-. Soft-start is the gradual ramping up of hammer energy, incrementally increasing over an agreed period of time, until full operational power is reached. Initiating piling at a lower hammer energy will effectively reduce the underwater noise levels allowing the animal to move away from the noise source to a greater distance at which the likelihood of injury is reduced. The duration of a soft start procedure will be no less than 20 minutes. The duration of the ramp-up procedure will depend on the required hammer energy for steady pile penetration. Based on the scenarios modelled, it is assumed that a 40-minute ramp-up will be conducted before maximum hammer energy is used (see Table 4–1 and Table 4–2).

4.5.6 Break in Piling Sequence

4.5.6.1 ADD activation will only be required prior to the installation of the first pile in a piling sequence within a 24-hour period, in order to minimise ADD use and, therefore, reduce any unnecessary disturbance to marine mammals. Should a break between pile installation(s) exceed six hours (including the transition from vibropiling to impact piling), then the ADD will need to be reactivated once impact piling is ready to commence again. This follows advice provided by NatureScot and MD-LOT on the Moray East Marine Mammal Mitigation Protocol (December 2018) and the procedure agreed for the Moray West Piling Strategy (Revised) Revised Appendix D: Piling Mitigation Protocol (April 2023). Studies have shown that harbour porpoise detections remain significantly reduced from baseline levels up to six hours after ADD activation and further studies in Germany showed reduced porpoise detection rates for 28-48 hours after the end of pile driving (Brandt *et al*., 2013a[13]; 2013b[14]; Rose *et al*., 2019[17]), although noting that several of these early studies included extensive use of ADD.

4.6 Reporting

4.6.1.1 The mitigation report will be submitted to MD-LOT. The content of the mitigation report will be agreed with MD-LOT post-consent.

4.6.1.2 Other reporting will be conducted in accordance with the requirements and conditions specified in the Consent, Marine Licence or EPS Licence, which will be determined post-consent (e.g., the submission of a close-out report via the UK MNR; JNCC, 2024[7]).

5 References

[1] Joint Nature Conservation Committee (JNCC) (2017) 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys'. Available at: https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4 (Accessed 01/10/2024)

[2] Department for Business Energy and Industrial Strategy (BEIS) (2020) 'Review of Consented Offshore Wind Farms in the Southern North Sea Harbour Porpoise Special Area of Conservation'. Available at: https://www.gov.uk/government/publications/review-of-consented-offshore-wind-farms-in-the-southern-north-sea-harbour-porpoise-special-area-of-conservation (Accessed 01/10/2024)

[3] Shell (2017) 'Bacton Near Shore Pipeline Inspection Survey – Noise Assessment'

[4] Department for Business Energy and Industrial Strategy (BEIS) (2019a) 'Spectrum Seismic Survey - Record of the Habitats Regulations Assessment undertaken under Regulation 5 of the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (As Amended) (Draft Report)'

[5] Department for Business Energy and Industrial Strategy (BEIS) (2019b) 'Offshore Oil and Gas Licensing 31st Seaward Round. Habitats Regulations Assessment Draft Appropriate Assessment: Irish Sea'

[6] Hartley Anderson Ltd (2020) 'Underwater acoustic surveys: review of source characteristics, impacts on marine species, current regulatory framework and recommendations for potential management options'. NRW Evidence Report No: 448, 119pp, NRW, Bangor, UK

[7] Joint Nature Conservation Committee (JNCC) (2024) 'Marine Noise Registry'. Available at: https://mnr.jncc.gov.uk (Accessed 01/10/2024)

[8] Ocean Winds (2024) 'Low order deflagration of unexploded ordnance reduces underwater noise impacts from offshore wind farm construction'. Ocean Winds, Seiche Ltd, University of Aberdeen, EODEX

[9] Joint Nature Conservation Committee (JNCC) (2023) 'Draft guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment'

[10] Southall, B., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D. and Tyack, P. (2019) 'Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects'. Aquatic Mammals 45: 125-232

[11] Graham, I.M., Pirotta, E., Merchant, N.D., Farcas, A., Barton, T.R., Cheney, B., Hastie, G.D. and Thompson, P.M. (2017) 'Responses of bottlenose dolphins and harbor porpoises to impact and vibration piling noise during harbor construction'. Ecosphere 8

[12] Joint Nature Conservation Committee (JNCC) (2010) 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise'. Available at: https://hub.jncc.gov.uk/assets/31662b6a-19ed-4918-9fab-8fbcff752046 (Accessed 01/10/2024)

[13] Brandt, M.J., Hoeschle, C., Diederichs, A., Betke, K., Matuschek, R. and Nehls, G. (2013a) 'Seal scarers as a tool to deter harbour porpoises from offshore construction sites'. Marine Ecology Progress Series 475: 291-302

[14] Brandt, M.J., Hoeschle, C., Diederichs, A., Betke, K., Matuschek, R., Witte, S. and Nehls, G. (2013b) 'Far-reaching effects of a seal scarer on harbour porpoises, *Phocoena phocoena*'. Aquatic Conservation-Marine and Freshwater Ecosystems 23: 222-232

[15] Gordon, J., Blight, C., Bryant, E. and Thompson, D. (2015) 'Tests of acoustic signals for aversive sound mitigation with harbour seals. Sea Mammal Research Unit report to Scottish Government'. MR 8.1 Report. Marine Mammal Scientific Support Research Programme MMSS/001/11

[16] McGarry, T., Boisseau, O., Stephenson, S. and Compton, R. (2017) 'Understanding the Effectiveness of Acoustic Deterrent Devices (ADDs) on Minke Whale (*Balaenoptera acutorostrata*), a Low Frequency Cetacean'. Report for the Offshore Renewables Joint Industry Programme (ORJIP) Project 4, Phase 2. Prepared on behalf of the Carbon Trust

[17] Rose, A., Brandt, M.J., Vilela, R., Diederichs, A., Schubert, A., Kosarev, V., Nehls, G., Volkenandt, M., Wahl, V., Michalik, A., Wendeln, H., Freund, A., Ketzer, C., Limmer, B., Laczny, M. and Piper, W. (2019) 'Effects of noise-mitigated offshore pile driving on harbour porpoise abundance in the German Bight 2014-2016 (Gescha 2)'. IBL Umweltplanung GmbH, Institut für Angewandte Ökosystemforschung Gmb, BioConsult SH GmbH & Co KG, Husum

[18] Boisseau, O., McGarry, T., Stephenson, S., Compton, R., Cucknell, A.C., Ryan, C., McLanaghan, R. and Moscrop, A. (2021) 'Minke whales *Balaenoptera acutorostrata* avoid a 15 kHz acoustic deterrent device (ADD)'. Marine Ecology Progress Series 667: 191-206

[19] Graham, I.M., Gillespie, D., Gkikopoulou, K.C., Hastie, G.D. and Thompson, P.M. (2023) 'Directional hydrophone clusters reveal evasive responses of small cetaceans to disturbance during construction at offshore windfarms'. Biol Lett 19: 20220101

[20] Thompson, P.M., Graham, I.M., Cheney, B., Barton, T.R., Farcas, A. and Merchant, N.D. (2020) 'Balancing risks of injury and disturbance to marine mammals when pile driving at offshore windfarms'. Ecological Solutions and Evidence 1: e12034

[21] Voß, J., Rose, A., Kosarev, V., Vílela, R., van Opzeeland, I.C. and Diederichs, A. (2023) 'Response of harbor porpoises (*Phocoena phocoena*) to different types of acoustic harassment devices and subsequent piling during the construction of offshore wind farms'. Frontiers in Marine Science 10

[22] Graham, I.M., Merchant, N.D., Farcas, A., Barton, T.R.C., Cheney, B., Bono, S. and Thompson, P.M. (2019) 'Harbour porpoise responses to pile-driving diminish over time'. Royal Society Open Science 6: 190335

[23] Benhemma-Le Gall, A., Thompson, P., Merchant, N. and Graham, I. (2023) 'Vessel noise prior to pile driving at offshore windfarm sites deters harbour porpoises from potential injury zones'. Environmental Impact Assessment Review 103: 107271

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