

DOGGER BANK D WIND FARM

Outline Marine Mammal Mitigation Plan

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OUTLINE MARINE MAMMAL MITIGATION PLAN

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Table of Contents

Table of Contents	2
Glossary	3
1 Purpose of this Document	6
1.1 Description of the Project	8
1.2 Consultation	10
2 Outline Protocols for Unexploded Ordnance Clearance and Piling	12
2.1 Unexploded Ordnance Clearance	12
2.1.1 Clearance Methodologies	13
2.1.2 Mitigation	15
2.1.3 Reporting.....	23
2.1.4 Communication and Responsibilities	24
2.2 Piling	25
2.2.1 Mitigation	26
References.....	36
List of Tables	38
List of Acronyms.....	38

Glossary

Term	Definition
Additional Mitigation	<p>Measures identified through the EIA process that are required as further action to avoid, prevent, reduce or, if possible, offset likely significant adverse effects to acceptable levels (also known as secondary (foreseeable) mitigation).</p> <p>All additional mitigation measures adopted by the Project are provided in the Commitments Register.</p>
Array Area	<p>The area within which the wind turbines, inter-array cables and offshore platform(s) will be located.</p>
Deemed Marine Licence (DML)	<p>A consent required under the Marine and Coastal Access Act 2009 for certain activities undertaken within the UK marine area, which may be granted as part of the Development Consent Order.</p>
Development Consent Order (DCO)	<p>A consent required under Section 37 of the Planning Act 2008 to authorise the development of a Nationally Significant Infrastructure Project, which is granted by the relevant Secretary of State following an application to the Planning Inspectorate.</p>
Effect	<p>An effect is the consequence of an impact when considered in combination with the receptor's sensitivity / value / importance, defined in terms of significance.</p>
Embedded Mitigation	<p>Embedded mitigation includes:</p> <ul style="list-style-type: none"> Measures that form an inherent part of the project design evolution such as modifications to the location or design of the development made during the pre-application phase (also known as primary (inherent) mitigation); and Measures that will occur regardless of the EIA process as they are imposed by other existing legislative requirements or are considered as standard or best practice to manage commonly occurring environmental impacts (also known as tertiary (inexorable) mitigation). <p>All embedded mitigation measures adopted by the Project are provided in the Commitments Register.</p>
Enhancement	<p>Measures committed to by the Project to create or enhance positive benefits to the environment or communities, as a result of the Project.</p> <p>All enhancement measures adopted by the Project are provided in the Commitments Register.</p>
Environmental Impact Assessment (EIA)	<p>A process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information and includes the publication of an Environmental Statement.</p>
Environmental Statement (ES)	<p>A document reporting the findings of the EIA which describes the measures proposed to mitigate any likely significant effects.</p>

OUTLINE MARINE MAMMAL MITIGATION PLAN

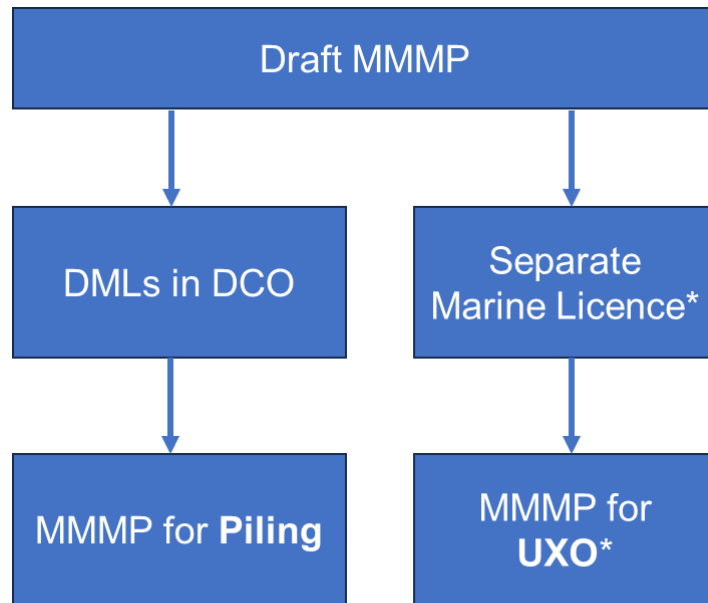
Term	Definition
Evidence Plan Process (EPP)	A voluntary consultation process with technical stakeholders which includes a Steering Group and Expert Topic Group (ETG) meetings to encourage upfront agreement on the nature, volume and range of supporting evidence required to inform the EIA and HRA process.
Expert Topic Group (ETG)	A forum for targeted technical engagement with relevant stakeholders through the EPP.
Impact	A change resulting from an activity associated with the Project, defined in terms of magnitude.
Inter-Array Cables	Cables which link the wind turbines to the offshore platform(s).
Mitigation	<p>Any action or process designed to avoid, prevent, reduce or, if possible, offset potentially significant adverse effects of a development.</p> <p>All mitigation measures adopted by the Project are provided in the Commitments Register.</p>
Monitoring	<p>Measures to ensure the systematic and ongoing collection, analysis and evaluation of data related to the implementation and performance of a development. Monitoring can be undertaken to monitor conditions in the future to verify any environmental effects identified by the EIA, the effectiveness of mitigation or enhancement measures or ensure remedial action are taken should adverse effects above a set threshold occur.</p> <p>All monitoring measures adopted by the Project are provided in the Commitments Register.</p>
Offshore Platform(s)	Fixed structures located within the DBD Array Area that contain electrical equipment to aggregate and, where required, convert the power from the wind turbines, into a more suitable voltage for transmission through the export cables to the Onshore Converter Station. Such structures could include (but are not limited to): Offshore Converter Station(s) and an Offshore Switching Station.
Preliminary Environmental Information Report (PEIR)	The PEIR provides a draft environmental assessment and information to support and inform the statutory consultation process in the pre-application phase. The PEIR will be updated to produce the Project's ES that will accompany the DCO application.
Scoping Opinion	<p>A written opinion issued by the Planning Inspectorate on behalf of the Secretary of State regarding the scope and level of detail of the information to be provided in the Applicant's Environmental Statement.</p> <p>The Scoping Opinion for the Project was adopted by the Secretary of State on 02 August 2024.</p>
Scoping Report	<p>A request by the Applicant made to the Planning Inspectorate for a Scoping Opinion on behalf of the Secretary of State.</p> <p>The Scoping Report for the Project was submitted to the Secretary of State on 24 June 2024.</p>

OUTLINE MARINE MAMMAL MITIGATION PLAN

Term	Definition
Sound Exposure Level (SEL)	The constant sound level acting for one second, which has the same amount of acoustic energy, as indicated by the square of the sound pressure, as the original sound. It is the time-integrated, sound pressure- squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels, and temporal characteristics.
Sound Pressure Level (SPL)	<p>The basic measure of how much sound there is at a given location. It is a measure of the size of the pressure fluctuations in the air that we perceive as sound.</p> <p>Sound Pressure Level is expressed in decibels with a reference level of 20×10^{-6} Pa (Lp in dB re 20 μPa).</p> <p>The sound pressure level or SPL is an expression of the sound pressure using the decibel (dB) scale, and the standard reference pressures of 1 μPa for water and 20 μPa for air.</p>
The Applicant	SSE Renewables and Equinor acting through 'Doggerbank Offshore Wind Farm Project 4 Projco Limited'.
The Project	Dogger Bank D Offshore Wind Farm Project, also referred to as DBD in this PEIR.
Wind Turbines	Power generating devices located within the DBD Array Area that convert kinetic energy from wind into electricity.

1 Purpose of this Document

1. The purpose of this Outline Marine Mammal Mitigation Plan (MMMP) for piling and unexploded ordnance (UXO) clearance is to demonstrate the principles of the final Marine Mammal Mitigation Plan (MMMP) to be submitted for approval under the Development Consent Order (DCO) for the proposed Dogger Bank D Offshore Wind Farm (hereafter 'the Project' or 'DBD').
2. Both UXO clearance and piling have the potential to produce underwater noise capable of causing auditory injury to marine mammals. This Outline MMMP details how the Project would reduce the risk of underwater noise of UXO clearance and piling from causing auditory injury to marine mammals that could be present in and around the Project.
3. It should be noted that prior to construction, a separate Marine Licence (ML) for UXO clearance will be sought, with the necessary information (including the final MMMP for UXO clearance), being provided through the marine licensing process. Proposed measures to mitigate potential impacts from UXO clearance have been provided within this Outline MMMP for information purposes only, consistent with Natural England's advice that the DCO application includes an assessment of potential UXO clearance.
4. As such, separate MMMPs for piling and UXO clearance would be developed for the Project at the pre-construction stage. These final MMMPs will take account of the most suitable mitigation measures and up to date scientific understanding at the time of construction. These measures will be consulted upon with the Marine Management Organisation (MMO) and Statutory Nature Conservation Bodies (SNCBs).
5. **Figure 1-1** highlights the relationship between the outline and final MMMPs for piling and UXO clearance and how they would be secured via the DML within the DCO and separate marine licence(s). Please note that at PEIR stage the Outline MMMP for piling and UXO is being presented as a combined single document (this document). At ES stage it is expected the Outline MMMP for piling and UXO will be separated into two separate Outline MMMP documents for piling and UXO respectively, in line with marine licencing requirements indicated by **Figure 1-1**.



**To be obtained post consent*

Figure 1-1 Relationship Between the Outline and Final MMMP for Piling and UXO and How They Would be Secured

6. This Outline MMMP for UXO clearance and piling sets out the plan of how the Project would:
 - Mitigate impacts to reduce the likelihood of injury to marine mammals as a result of underwater noise during UXO clearance; and
 - Mitigate impacts to reduce the likelihood of injury to marine mammals as a result of underwater noise during piling operations.
7. This Outline MMMP will be updated prior to DCO to take into account any changes to project design that result in updates to the underwater noise modelling results (**Volume 2, Appendix 12.3 Underwater Noise Modelling Report**), on which the mitigation provided within this Outline MMMP is based. Feedback received from stakeholders through the statutory consultation will also be considered where appropriate in the Outline MMMP to be submitted with the DCO application.

8. The final MMMP for piling and UXO will be submitted to the MMO prior to commencement of offshore piling, for approval in consultation with the relevant SNCBs. It will be based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. Current guidance includes Joint Nature and Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from UXO clearance (JNCC, 2025), statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010) and JNCC guidance for the use of Passive Acoustic Monitoring (PAM) in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023). It also reflects the latest guidance on alternatives to high-order detonation of UXOs within the marine environment (UK Government *et al.*, 2025a) and the joint interim statement distributed in January 2025 which sets the position on the use of lower noise emitting UXO clearance methods.

1.1 Description of the Project

9. The Project's Array Area is located in the Dogger Bank region of the southern North Sea, approximately 210km off the Yorkshire coast at its nearest point. The size of the Array Area is approximately 262km².
10. The minimum and maximum water depths within the Array Area are approximately 21.2 – 34.6m relative to the lowest astronomical tide (LAT) (**Volume 1, Chapter 8 Marine Physical Processes**).
11. Once built, the Project would comprise the following offshore components:
 - The offshore wind turbines and their associated foundations;
 - Scour protection around foundations and subsea cables as required;
 - Up to two offshore platforms; and
 - Subsea cables comprising:
 - Array cables between the turbines and offshore platforms; and
 - Offshore export cables between the offshore platforms and landfall.
12. The detailed design of the Project (e.g. numbers of wind turbines, layout configuration, foundation type and requirement for scour protection) would be determined post-consent. Therefore, the key parameters presented in **Table 1-1** are indicative based on current information and assumptions. These parameters have formed the worst-case scenario for the underwater noise assessment as presented in **Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.

OUTLINE MARINE MAMMAL MITIGATION PLAN

13. The earliest any offshore construction works would start is assumed to be 2029 and would require up to five years (excluding pre-construction activities such as surveys)¹.

Table 1-1 Key Relevant Parameters

Parameter	Detail
Approximate offshore construction duration (years)	4
Application area for Array Area (excluding offshore temporary works area) (km ²)	262
Maximum length of export cable to landfall (per cable) (km)	400
Maximum export cable length (km) for all cables	800
Maximum number of export cables and trenches	2 cables / trenches of 400km
Array Area water depth range (m)	21.2 – 34.6
Distance from Array Area to coast (closest point) (km)	210
Maximum number of wind turbines	113
Maximum number of offshore platforms	2
Wind turbine foundation type options	<ul style="list-style-type: none"> • Monopiles; • Piled jacket foundation; and • Suction bucket jackets².
Offshore platforms foundation type options	<ul style="list-style-type: none"> • Monopiles; • Piled jacket foundation; • Suction bucket foundation²; • Gravity base foundation²; and • Arup Concept Elevating platform².
Number of piles per foundation for wind turbines	<ul style="list-style-type: none"> • 113 monopiles; and • 904 pin-piles for jacket foundation.

¹Any pre-construction geophysical surveys undertaken will be applied for separately following latest regulatory guidelines, including submission to the Marine Noise Registry, and following JNCC (2017) *JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys* as standard.

² Underwater noise is not associated with this foundation type and thus would not require mitigation. The information in the table merely presents the foundation options currently considered.

OUTLINE MARINE MAMMAL MITIGATION PLAN

Parameter	Detail
Maximum number of piles for platforms	<ul style="list-style-type: none">• 10 monopiles; and• 20 pin-piles for jacket foundation.
Hammer energies (kilojoules) (kJ)	<ul style="list-style-type: none">• 8,000kJ for monopiles; and• 5,000kJ for pin piles.
Maximum pile diameter (m)	<ul style="list-style-type: none">• Up to 18m for monopiles; and• 5m for pin piles.

1.2 Consultation

14. During consultation on the Scoping Report (Royal HaskoningDHV, 2024) and at the Marine Mammal Expert Topic Group (ETG) meetings, comments relevant to the MMMP were received and the Project responses are provided in **Table 1-2**.

OUTLINE MARINE MAMMAL MITIGATION PLAN

Table 1-2 Consultation Responses on Marine Mammal Mitigation

Consultee	Date	Comment	Project Response
Natural England	Feedback from DBD ETG3 meeting 1 and Method Statement (05/12/23)	We welcome the approaches outlined in Section 5 of the method statement. However, Natural England cannot scope out impacts based on embedded mitigation to be included in future plans, unless we have seen those plans to agree the mitigation is sufficient. We advise that relevant draft plans (for example MMMP, VMP, CEMP) are provided alongside the Preliminary Environmental Information Report (PEIR) or at the point of application.	Noted. DBD has provided outline plans at the point of PEIR consultation to support Natural England's review. Embedded mitigation measures for UXO clearance are described in Section 2.1 and for piling in Section 1.1 .
MMO	Feedback from DBD ETG3 meeting 1 and Method Statement (23/01/24)	It is not possible to comment fully on the MMMP at this stage. However, in terms of the general approach, the MMO agree that "the pre-piling search area will be based on the instantaneous PTS ranges (and therefore may be larger than the standard 500m as defined by JNCC)". The extent of this search area / mitigation zone (MZ) will need to be considered during the environmental impact assessment and agreed with the regulatory authority. As per the JNCC (2010) guidance, the radius of the MZ should be no less than 500 metres, and this is measured from the pile location.	Noted. DBD has provided outline plans at the point of PEIR consultation to support Natural England's review. The MZ will cover the largest impact range for marine mammal PTS from hammer strike at full energy, predicted through the underwater noise modelling which is referenced in Section 1 .
Planning Inspectorate	Scoping Opinion (02/08/24)	Paragraph 211 of the Scoping Report confirms that draft or outline copies of relevant mitigation and management plans will be appended to the ES and / or submitted with the DCO application as relevant. It is unclear whether these would include a draft Marine Mammal Mitigation Plan (MMMP) or Draft / In Principle Site Integrity Plan. It is recommended that a draft MMMP and Draft / In Principle SIP are provided with the DCO application, as relevant.	Agreed. This Outline MMMP is being submitted at PEIR for consultation. A revised Outline MMMP will be submitted with the DCO application.
Natural England	Scoping Opinion (02/08/24)	"We advise that the following mitigation documents should be provided at the DCO application stage: <ul style="list-style-type: none"> MMMP (Marine Mammal Mitigation Plan) 	Agreed.

2 Outline Protocols for Unexploded Ordnance Clearance and Piling

2.1 Unexploded Ordnance Clearance

15. Based on previous experience in offshore wind projects in the North Sea, including in the wider Dogger Bank area, there is a likely requirement for UXO clearance prior to construction. Whilst the preference would be to avoid any underwater UXO that are identified, it is necessary to consider the potential for underwater UXO detonation where retrieval is deemed to be unsafe and avoidance is not possible.
16. The purpose of this Outline MMMP is to demonstrate the principles of the final MMMP for any UXO clearance at the Project.
17. This Outline MMMP outlines the mitigation to reduce the risk of injury, including permanent auditory injury / a permanent shift in hearing sensitivity (Permanent Threshold Shift (PTS)), to marine mammals during any UXO clearance work associated with the Project (including the Array Area and offshore cable corridors).
18. The final MMMP for UXO clearance would be submitted for approval under a future ML application, separate from the DCO application.
19. The exact number, type or size of UXO and duration of UXO clearance operations are not known at this stage. Therefore, the final detailed MMMP for UXO clearance would be developed pre-construction based on the latest survey information which would provide detailed information on the UXO clearance which could be required. The final MMMP for UXO clearance would provide details of the predicted impact (PTS) ranges and areas from UXO clearance.
20. The final MMMP for UXO clearance would ensure there are embedded mitigation measures, as well as any additional mitigation, if required, to reduce the risk of physical or permanent auditory injury (PTS) to marine mammals. This would incorporate the most appropriate mitigation measures based upon best practice, guidance and information and proven methodologies at that time. This also includes updated underwater noise modelling, if required, and would be updated no later than four months prior to UXO clearance activities being undertaken.
21. The Project is committed to using the best practicable means at the time to mitigate the impacts to marine mammals of the Project.

2.1.1 Clearance Methodologies

22. In line with the UK Regulator's Position Statement on the Clearance of UXO³, the methods of clearance, in order of preference, would be as follows:

- UXO will be avoided and left *in-situ*, only if safe and possible to do so.
- Micro-siting of infrastructure, if possible, to avoid any potential UXO, so clearance is not required.
- Relocation of UXO to where it is not in close proximity to existing or planned infrastructure, so clearance is not required. For example, UXO will be lifted and shifted to a safe location. If the UXO appears structurally sound and there is no risk, the UXO could be moved to a location that does not pose a risk to construction activities.
- If the above options are not possible (or safe to implement), then UXO clearance would be required. The order of preference for any clearance would be as follows:
 - Low-order clearance. Only in the event that low-order clearance is not possible (or safe), and the following three conditions are met, then high-order clearance may be used:
 - The most appropriate low noise method has failed after at least three attempts;
 - All best practice has been clearly applied; and
 - There is prior agreement with the appropriate licensing authority.
 - High-order clearance with bubble curtain. Only in the event that it is not possible (or safe) to use bubble curtains, then;
 - High-order clearance with no bubble curtain.

³ <https://www.gov.uk/government/publications/marine-environment-unexploded-ordnance-clearance-joint-position-statement/marine-environment-unexploded-ordnance-clearance-joint-position-statement>

2.1.1.1 Low-Order Unexploded Ordnance Clearance Techniques

23. Low-order UXO clearance techniques, where the ordnance is disposed of or rendered safe without a high-order detonation is the preferred option for clearance for this work. Examples of low-order techniques include (National Physical Laboratory (NPL), 2020):
 - Freezing the munition to render it inactive;
 - Water abrasive suspension cutting in order to physically disrupt the munition;
 - Disposal in a Static Detonation Chamber;
 - Photolytic destruction of the munition; and
 - Low-order deflagration.
24. While all of the above are viable options, deflagration is the most trialled and tested technique. Deflagration is a technique whereby the explosive within the UXO is rapidly burned at subsonic speeds using plasma from a small, shaped charge that generates insufficient shock to detonate the UXO (Merchant and Robinson, 2020; NPL, 2020). The explosive material inside the UXO reacts with a rapid burning rather than a chain reaction that would lead to a full explosion (NPL, 2020).
25. Substantial noise reduction for deflagration over high-order (SPL_{peak} and Sound Exposure Level (SEL) are more than 20 decibels (dB) lower) and acoustic output for deflagration depends only on the size of the shaped charge (rather than the size of the UXO) (NPL, 2020; Robinson *et al.*, 2020).
26. The technique of low-order clearance appears to present a viable option to avoid high-order explosive detonation. Low-order techniques, such as deflagration, are relatively new to civilian applications but have been used by the UK military since 2005 (Merchant and Robinson, 2020).
27. A number of OWFs have successfully used low-order deflagration in order to clear a range of UXOs, including Moray West, where a total of 82 UXOs (all that required clearing) were cleared by this technique (Ocean Winds, 2024). Low-order deflagration was successfully used at a range of UXO types (including projectiles, anti-submarine weapons, air dropped weapons and German Luftmines) and sizes, ranging from 6kg to 700kg Net Explosive Quantity, with none resulting in a high-order detonation. Donor charges were 250g per device.

28. In the event that low-order clearance was unsuccessful or deemed unsuitable for a specific UXO (e.g. due to its condition) high-order detonation may need to be undertaken. Furthermore, there is potential for a low-order deflagration to result in a high-order detonation even though the probability of this occurring is very low. In such cases, appropriate reporting according to the guidance set out by the UK Government *et al.* (2025b) must be followed.

2.1.2 Mitigation

29. The Project would ensure that the mitigation measures are adequate to reduce the risk of any physical or permanent auditory injury (PTS) within the monitoring area during all UXO clearance.
30. The final MMMP would involve the establishment of a suitable monitoring area around a UXO location before any UXO clearance. The monitoring area is the entire area for the maximum PTS ranges or 1km, whichever is larger.
31. The methods for establishing the monitoring area and reducing the potential impacts of any UXO clearance would be agreed with the MMO in consultation with the relevant SNCBs and would be secured as commitments within the final MMMP.
32. The UXO clearance mitigation measures could include:
 - Low-order disposal techniques (see **Section 2.1.1.1**); as outlined above, would be the preferred method for all UXO clearance events;
 - Establishment of a monitoring area with a minimum of 1km radius (see **Section 2.1.2.1**):
 - A pre-clearance search of the monitoring area during daylight hours and when conditions allow suitable visibility would be conducted by trained, dedicated and experienced Marine Mammal Observers (MMOb) (see **Section 2.1.2.3**);
 - Deployment of PAM in the monitoring area (see **Section 2.1.2.4**), if the equipment can be safely deployed and retrieved; and
 - Monitoring area would be visually monitored during and post UXO clearance.
 - The activation of Acoustic Deterrent Devices (ADD) (see **Section 2.1.2.5**) prior to all UXO low-order clearance or high-order detonation (with or without bubble curtains); and
 - The use of a Noise Abatement System (NAS) such as bubble curtains if high-order UXO detonation is required (see **Section 2.1.2.5**) taking into account the environmental conditions within which they could be effective;

- All UXO clearance taking place in daylight and, when possible, in favourable conditions with good visibility (sea state 3 or less).
 - Other UXO clearance techniques, such as avoidance or relocation of UXO would also be considered, if required and suitable (as outlined above); or
 - The UXO clearance and disposal would be undertaken by specialist contractors, using the minimum amount of explosives required in order to achieve safe disposal of the device.
33. If these options are not possible, and UXO clearance is the only option, then low-order clearance would be the preferred method. High-order detonation would only be used if low-order clearance was unsuccessful or the UXO device is unsafe for low-order clearance.
34. It is important to note these techniques and options are presented as current examples, but the mitigation options would be reviewed and updated based on the latest information and guidance in the final MMMP.

2.1.2.1 Monitoring Area

35. The monitoring area is the area over which a pre-detonation search (see **Section 2.1.2.3**) would be undertaken by trained, dedicated and at least one experienced MMOB. The monitoring area, based on current guidance (JNCC, 2025) and the distance over which MMOB can undertake effective observations, would have a radius of at least 1km from the UXO location, or the extent within PTS could occur, whichever is larger.
36. Where the MZ is larger than 1km, the MMOs should endeavour to observe as much of the required area as possible. Additional measures should be employed alongside the visual search to reduced risks to marine mammals (e.g. ADDs or noise abatement).

2.1.2.2 Marine Mammal Observers

37. Marine mammal observations would be undertaken by JNCC accredited MMOB. They may be subcontractors or assigned installation vessel crew members that have undertaken the JNCC MMOB course and would be available as dedicated⁴ and experienced⁵ MMOB, when required, taking into account their other duties.
38. The MMOB would be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with ranging reticles and reporting forms. The MMOB would scan the monitoring area with the unaided eye and use binoculars when needed to look in detail at an area where a possible sighting has been made. Binoculars should not be used continually as they restrict peripheral vision and views close to the vessel.

2.1.2.3 Pre- Clearance Search

39. The pre-clearance search will be undertaken for at least one hour prior to clearance taking place (or prior to ADD activation) and will cover the full monitoring area. This pre-clearance search will be undertaken either solely by MMOB, or by both MMOB and PAM (JNCC, 2025).
40. At least two MMOB would conduct surveys to cover the entire monitoring area. Marine mammal observations would be carried out from vantage points to allow unobstructed observations of the entire monitoring area. Observations should only take place in good visibility conditions⁶, and should be delayed if these visibility conditions are not met.
41. Following the pre-clearance search and confirmation of no marine mammal presence within the final 20 minutes⁷, the clearance should take place immediately.
42. Marine mammal observations would be carried out to monitor the monitoring area before ADD activation and prior to, during and after UXO clearance.

⁴'Dedicated' is defined as a trained MMOB with the sole purpose of undertaking visual observations to detect marine mammals.

⁵'Experienced' is defined as minimum of 20 weeks experience of implementing JNCC guidelines in UK water over the past ten years.

⁶ Good visibility = sea states of 3 or below (Beaufort) or s or g (JNCC), the full MZ can be clearly seen, and light levels are sufficient to observe the full MZ

⁷ The duration of 20 minutes may be altered in the case of a larger than 1km MZ, and will be sufficient to allow all marine mammal species time to clear the MZ, taking into account coastlines if undertaken nearshore.

43. The pre-clearance search would commence prior to all clearance events, or after any break in the clearance event, and at the end of a clearance event. The visual observations by the MMOb would commence at least one hour prior to the clearance event. This would continue until one hour has passed and no marine mammals have been detected within the monitoring area. The MMOb would then advise that the UXO clearance can commence. The ADD would be activated during the monitoring period at a time so that the end of ADD activation coincides with the end of the monitoring period prior to the UXO clearance.
44. If a marine mammal is detected within the monitoring area during the pre-clearance search, then the commencement of the UXO clearance procedure would be delayed. If a marine mammal has been sighted within the monitoring area, it would be monitored and tracked until it is clear of the monitoring area, and the Explosive Ordnance Disposal (EOD) team notified. The marine mammal(s) must be clear of the monitoring area for at least 20 minutes before the UXO clearance commences.
45. During ADD activation, if animals are sighted within the monitoring area, they would be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the monitoring area, then the clearance event would be delayed, and the full mitigation procedure, including the pre-clearance search, would be undertaken again.
46. If the marine mammal(s) remains clear of the monitoring area for at least 20 minutes (30 minutes in water depth > 200m) and the one-hour pre-search has been completed, and the required ADD activation time has been completed, then the UXO clearance can commence. A precautionary approach would always be used. Therefore, if the MMOb cannot be sure whether a marine mammal is within the monitoring area or not, then the UXO clearance would be delayed accordingly until the MMOb are sure that there are no marine mammals present within the monitoring area.
47. All MMOb must be a safe distance from the clearance site prior to any UXO clearance.
48. The MMOb would continue observations during ADD activation, bubble curtain activation (if required) and all UXO clearances.
49. In the case of an operational delay to a clearance event, a decision between the MMOb and the vessel crew should be undertaken based on the length of the delay. If there is a significant delay, then the pre-clearance search should be postponed and re-started at the appropriate time prior to clearance. In all cases, a full (and continuous) pre-clearance search must be undertaken prior to the clearance event, with no marine mammals present within the final 20 minutes.
50. Marine mammal observations would be carried out to monitor the monitoring area during:

- The pre-detonation search;
 - ADD activation;
 - Bubble curtain activation (if it is required);
 - UXO clearance; and
 - The post-detonation search (a period of 15 minutes following the clearance event).
51. The MMOb would record all periods of marine mammal observations, including start and finish time of pre-detonation searches, ADD activation, bubble curtain activation (if required), and conditions during observations (e.g. sea state, visibility, weather, etc.). Any sightings of marine mammals around the vessel(s) would also be recorded. The MMOb would complete the relevant marine mammal recording form(s) and reporting (see **Section 2.1.3**).
52. There would be clear communication channels between the MMOb, the ADD operator and the EOD team (see **Section 2.1.4**). The communication procedures would be established and agreed prior to any UXO clearance with regards to the communication of any marine mammals observed within the monitoring area, the deployment of ADD, and when the monitoring area is clear for the UXO clearance to commence.

2.1.2.4 Passive Acoustic Monitoring

53. The use of PAM (if required) should be considered to supplement visual observations. It will only be used in conjunction with MMOb, not instead of, and in daylight and in favourable conditions with good visibility (sea state 3 or less⁶).
54. If required, the use of PAM would be undertaken by trained, dedicated and experienced⁵ PAM Operators (PAM Ops). PAM Ops would be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment would be appropriate to detect vocalising cetaceans in the full monitoring area. PAM Ops would be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all UXO clearance.
55. The PAM equipment should cover as much of the monitoring area as possible with minimal vessel noise interference and detect all required frequencies of species likely to be in the area. An individual should not perform dual roles as MMO and PAM operator simultaneously, thus when using PAM, two MMOb should still monitor the monitoring area. PAM monitoring should start at least 60 minutes before the planned clearance.
56. The PAM equipment should be deployed such that it can cover as much of the monitoring area as is possible, whereby the detection range for some species need to be taken into consideration. The PAM system should be capable of detecting all the required frequencies of species likely to be in the area.

57. PAM monitoring should start at least 60 minutes before the planned clearance. Upon confirmation by the MMOs, if there are no marine mammals in the monitoring area, clearance should begin immediately.
58. Details on further JNCC guidance for the use of PAM from offshore activities can be found in JNCC, 2023.

2.1.2.5 Acoustic Deterrence Device (ADD)

59. The MZ for potential injury would be determined based on the maximum range for PTS using the impacts range from cumulative sound exposure level (SEL_{cum}) from the Project underwater noise modelling. The range of the MZ and the relative species swim speed would be used to define the duration of the ADD activation time. The maximum duration of the ADD activation time would also be determined to reduce risk of increased disturbance. Note that the required duration would be confirmed within the final MMMP post-consent.
60. An ADD would be activated prior to any UXO low-order clearance or high-order detonation to ensure marine mammals are deterred from the area and reduce the risk of any physical or auditory injury.
61. ADDs have proven to be effective mitigation for porpoise *Phocoena phocoena*, minke whale *Balaenoptera acutorostrata*, grey seal *Halichoerus grypus*, and harbour seal *Phoca vitulina* (Sparling *et al.*, 2015; McGarry *et al.*, 2017, 2020). ADDs have been widely used as mitigation to deter marine mammals during offshore wind farm piling and UXO clearance at sites in Europe (for example, Brandt *et al.*, 2011, 2012, 2013a,b) and offshore wind farm sites in the UK, including but not limited to, Galloper, Dudgeon Offshore Wind Farm, East Anglia ONE, Moray East, and Dogger Bank A, B and C.
62. The type and model of ADD would be determined in the final MMMP for UXO clearance, based on the latest information and advice, and would provide sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the MZ, if greater than 1km.
63. The ADD would be tested prior to the pre-clearance search to ensure it is working correctly. If there are any technical problems with the ADD then, if required, the UXO clearance would be delayed until these issues are resolved. A back-up ADD would be present on board, in case there are issues with activation of the primary system.
64. The ADD would be deployed and ready to be activated prior to UXO clearance and activated after a minimum of 30 minutes of the pre-clearance search. If a marine mammal is detected within 100m of the ADD during this search, the ADD activation will be delayed until the animal is at least 100m away from the ADD.

OUTLINE MARINE MAMMAL MITIGATION PLAN

65. If an animal is observed in the monitoring area during the pre-clearance search, once the ADD is active, the ADD should remain switched on. If there is a delay to the clearance due to marine mammal presence in the monitoring area, then the ADD should remain active for the duration of that delay. If, however, the delay is extended and the animal is not moving away, the ADD should be switched off to prevent habituation to the sound. If the animal stays more than 100m of the ADD, the ADD should be reactivated after 20 minutes, and be activated for the required time prior to clearance.
66. The ADD would be positioned within the water column to ensure that sound can be emitted in all directions. The ADD would be deployed from a vessel as close as possible to the clearance site, where it is safe to be positioned prior to the commencement of the UXO clearance.
67. The best locations to deploy the ADD, and the method to provide power to the device, would be decided through a pre-deployment survey of the vessel or vessels by the ADD operator(s), MMOB, EOD supervisor and vessel operational manager. Once the best locations for the ADD have been determined, the control unit and power supply would be temporarily installed. For deployment of the ADD, the transducer part of the device would be lowered over the side of the deck to a water depth that is below the draft of the vessel to ensure the sound can be emitted in all directions and not dampened by the presence of the vessel.
68. The ADD would be activated at a time so that the end of ADD activation coincides with the end of the monitoring period, immediately prior to either the bubble curtain activation (if being used) or clearance event to allow marine mammals to move beyond the area of potential PTS risk.
69. The ADD would not be activated during transit to another clearance event and would be activated prior to all clearance events.
70. After the ADD has been activated for the required duration, the ADD operator would deactivate and recover the ADD and undertake routine checks to ensure it is still working correctly, ready for the next deployment and activation.
71. The ADD activation times for low-order clearance, high-order detonation with bubble curtain and high-order detonation without bubble curtain would be determined based on the maximum potential area for PTS.

2.1.2.6 Bubble Curtains

72. Where possible, bubble curtains would be used for any high-order detonations to reduce underwater noise impacts from the explosion.
73. Bubble curtains are a flexible system of tubes fitted with special nozzle openings which can be installed on the seabed at a sufficient radius around the UXO. A specialist vessel that is designed specifically for the launch and recovery of the bubble curtain would be used and fitted with large hose reels and a number of air compressors. Compressed air would be discharged via the hose nozzles prior to and during the detonation, causing a curtain of continually rising air bubbles that surround the water column around the UXO location. This process changes the physical condition of the water column with regard to underwater acoustics and upon detonation, acoustic waves are repeatedly broken, theoretically limiting their spatial extent.
74. It is important to consider the environment that the bubble curtains would be deployed in prior to deployment, to ensure that they are effective, safe to deploy and taking in to account the contractor's limitations safety restrictions. Key considerations are environmental constraints such as water depth, current speeds and wave height. Note that six high-order clearances with bubble curtains were carried out successfully at Dogger Bank B Offshore Wind Farm in February 2023.
75. It is understood that, currently, it is possible to deploy bubble curtains for UXO detonation under the following scenarios (based on Verfuss *et al.* 2019):
 - Water depths are between approximately 5m and 40m;
 - Significant wave heights are less than approximately 1m;
 - Maximum wind speed is less than approximately 8 metres per second (m/s); and
 - Current speeds are less than approximately 1.5knots.
76. The above figures are subject to change and would be dependent on available technology at the time of any potential detonations. The exact parameters for the safe deployment of bubble curtains will be confirmed in the final MMMP with the information from the assigned contractor.
77. Once the bubble curtain is in place and prior to the bubble curtain being activated an explosive charge would be attached to, or placed next to, the UXO by a Remotely Operated Vehicle, and detonation would be undertaken remotely.
78. Bubble curtains should not be switched on until the end of the pre-clearance search and there are no marine mammals within 1km of the activity. This is to ensure they do not become trapped within the curtain.

79. While bubble curtains are currently the only viable option to reduce the noise from UXO clearances, other NAS options may become available in the future once sufficient information on its effectiveness is available and has been tested.

2.1.3 Reporting

80. Reports detailing all UXO clearance activity and mitigation measures would be prepared. This would include, but not necessarily be limited to:
- A record of the company awarded the licence, the licence number and the contractor who undertook the works;
 - A record of UXO clearance operations detailing date, location and times including information on the clearance methods, type and size (Trinitrotoluene (TNT) equivalent) of UXO, and size of charges used (TNT equivalent);
 - A record of any activities or circumstances that influenced the time / date the clearance took place (e.g. due to SIMOPs agreements);
 - A record of all mitigation personnel and their experience levels;
 - A record of mitigation measures such as ADD deployment, including the date, location, times, any operational issues, start and end times of watches by MMOB, locations of MMOB, start and end times of any acoustic monitoring using PAM, details of PAM equipment and software used, ADD equipment used (including operating frequencies), and details of all explosive activity during the relevant watches;
 - A flowchart to show the full mitigation procedure;
 - A record of any NAS used, including type, deployment method and locations relative to UXO location;
 - A record of all occasions when UXO detonation occurred, including details of the activities used to ensure the monitoring area and MZ is established and any occasions when activity was delayed or stopped due to presence of marine mammals;
 - Any relevant details on the efficiency of the marine mammal exclusion methodology;
 - A record of marine mammal observations, conditions, description of any marine mammal sightings and any actions taken; and
 - Details of any problems encountered including any instances of non-compliance with the agreed mitigation plan.
81. If high-order clearance methods are used, clear evidence should be included to demonstrate that low-order was attempted three times, with detail on investigations into failure reasons, and changes made to the process in order for low-order clearance to be successful upon further attempts.

82. All licenced activities would be listed (including the use of ADDs) on the Marine Noise Registry and a close out report submitted no later than 12 weeks after the completion of the licenced activities.
83. A final post-clearance report would be submitted to the MMO. The final report would include any data collected during UXO clearance operations, details of all mitigation measures, a detailed description of any technical problems encountered and what, if any, actions were taken. The report would also state the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future projects. It is further recommended that the following should be included as appendices:
 - A detailed noise monitoring report;
 - A completed JNCC marine mammal mitigation spreadsheet; and
 - A target investigation report.

2.1.4 Communication and Responsibilities

84. The final MMMP would detail the communication protocol to ensure that all marine mammal mitigation measures are successfully undertaken for all UXO clearance operations.
85. The final MMMP would also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken. This would be developed based on the mitigation measures and personnel required (e.g. ADD operator, MMOb, PAM Ops, EOD team / UXO Manager, Environmental Liaison Officer (ELO)) with the titles and responsibilities being refined depending on the contractual agreement.

2.2 Piling

86. Depending on the installation method for the installation of the foundations for the wind turbines and platforms, impact piling could be required.
87. The purpose of this Outline MMMP is to demonstrate the principles of the final MMMP for piling that could be required for the Project. This Outline MMMP for piling sets out the proposed mitigation to reduce the likelihood of any injury, including any PTS, to marine mammals during all piling operations for the Project.
88. The final MMMP for piling would be developed and agreed in consultation with the MMO and relevant SNCBs. prior to commencement of offshore piling, when there would be more detailed information on the Project design. The final MMMP would incorporate the most appropriate mitigation measures based upon the latest and best available information including the latest best practice, guidance and updated underwater noise modelling, if required.
89. The final MMMP would be based on the final selected foundation types for the Project. It is noted that the worst-case foundation type is monopiles, which require an installation method using a heavy-weight hammer (known as impact driving) has been assessed in the PEIR. However, other foundation types such as gravity base structure or suction bucket foundation and alternative methods such as vibro-piling or drilling will could also be utilised in the Project final design. While these alternative foundations would be determined by technical and commercial requirements, they would lead to a reduction in potential noise effects which would be considered in the mitigation requirements of the final MMMP.
90. The final MMMP would include details of the embedded mitigation, such as the soft-start and ramp-up, as well as details of the monitoring area and any additional mitigation measures required to minimise potential impacts of any physical injury or PTS. Consideration would be given to the requirements following any breaks in piling as well as prior to piling commencing.
91. The aim of the MMMP for piling is to reduce the risk of PTS during piling from either wind turbine or offshore platforms foundations installation from:
 - First strike of the starting hammer energy of the soft start;
 - Single strike of the maximum hammer energy; and
 - Cumulative exposure during installation would be based on worst-case for the maximum number of monopiles or pin-piles installed sequentially in the same 24-hour period.
92. Underwater noise modelling would be used to derive the maximum potential PTS ranges.

2.2.1 Mitigation

93. The final MMMP would involve the establishment of a monitoring area and MZ around the pile location before each pile driving activity, based on the maximum predicted distance for PTS. The final MMMP for piling would provide details of the maximum predicted impact (PTS) ranges and areas for piling.
94. The Project would ensure that the mitigation measures are adequate to minimise the risk of marine mammals being present within the monitoring area and MZ prior to piling activity commencing, to reduce the risk of any physical or auditory injury (PTS).
95. The methods for establishing the monitoring area and MZ and reducing the potential impacts of piling operations would be agreed with the MMO in consultation with the relevant SNCBs and would be secured as commitments within the final MMMP.
96. The piling mitigation measures could include:
- Establishment of a monitoring area with a minimum 500m radius (**Section 2.2.1.0**);
 - The observation of the monitoring area conducted by trained, dedicated and experienced MMOb during daylight hours and when conditions allow suitable visibility (visibility of entire monitoring area; sea state 3 or less); (See **Section 2.2.1.2**).
 - Deployment of PAM devices in the monitoring area in conjunction with MMO and during poor visibility or at night (See **Section 2.2.1.3**).
 - The activation of ADD (see **Section 2.2.1.5**);
 - Soft-start and ramp-up (see **Section 2.2.1.6**); and
 - Procedure for breaks in piling (see **Section 2.2.1.7**).

2.2.1.1 Monitoring Area

97. The MMMP would involve the establishment of a monitoring area with a minimum radius of 500m around each wind turbine location and offshore platform location before piling for the Project.
98. The radius of the monitoring area would be greater than the maximum predicted impact range for PTS based on the maximum predicted distance for instantaneous PTS (SPL_{peak}) for marine mammal species that could be present in or around the Project.
99. The requirement for a minimum radius of 500m is in line with the current JNCC (2010) guidelines, to reduce the risk of PTS.
100. The monitoring area would be observed for a minimum of 30 minutes prior to soft-start commencing.

2.2.1.2 Marine Mammal Observers

101. Marine mammal observations would be undertaken by JNCC accredited MMOB. MMOB would have undertaken the JNCC MMOB course and would be available as dedicated⁸ observers.
102. At least two MMOB (including at least one experienced⁹ observer) would conduct surveys to cover the entire monitoring area around each pile location. Marine mammal observations would be carried out from vantage points to allow unobstructed observations of the entire monitoring area.
103. The MMOB would be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with ranging reticles and reporting forms. The MMOB would scan the monitoring area with the unaided eye and use binoculars when needed to look in detail at an area where a possible sighting has been made. Binoculars should not be used continually as they restrict peripheral vision and views close to the vessel. Marine mammal observations would be carried out to monitor the monitoring area:
 - Prior to and during ADD activation;
 - During the soft-start and ramp-up procedures; and
 - During any breaks in piling prior to piling recommencing.

⁸'Dedicated' is defined as a trained MMOB with the sole purpose of undertaking visual observations to detect marine mammals.

⁹'Experienced' is defined as minimum of 20 weeks experience of implementing JNCC guidelines in UK water within the previous five years.

104. Where possible, MMOB would continue monitoring during piling to allow for any breaks in piling.
105. The pre-piling monitoring would commence prior to all piling events, or after any break in piling. The visual observations by the MMOB would commence at least 30 minutes prior to the soft-start commencing. This would continue until 30 minutes have passed and no marine mammals have been detected within the monitoring area within the final 20 minutes, the MMOB would then advise that the soft-start can commence. The ADD would be activated during the monitoring period at a time so that the end of ADD activation coincides with the end of the monitoring period prior to the soft-start.
106. If a marine mammal is detected within the monitoring area during the pre-piling monitoring, then the commencement of the ADD activation and soft-start would be delayed. If a marine mammal has been sighted within the monitoring area, it would be monitored and tracked until it is clear of the monitoring area and the Piling Supervisor notified. The marine mammal(s) must be clear of the monitoring area for at least 20 minutes before the ADD activation and the commence of soft-start.
107. During ADD activation, if animals are sighted within the monitoring area, they would be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the monitoring area, then the soft-start would be delayed, and the full mitigation procedure, including the pre-monitoring, would be undertaken again.
108. If the marine mammal(s) remains clear of the monitoring area for at least 20 minutes and the pre-piling monitoring has been completed, and the required ADD activation time has been completed, then the soft-start can commence. A precautionary approach would always be used. Therefore, if the MMOB cannot be sure whether a marine mammal is within the monitoring area or not, then the soft-start would be delayed accordingly until the MMOB are sure that there are no marine mammals present within the monitoring area.
109. The MMOB would record all periods of marine mammal observations, including start and finish time of observations, when soft-start and piling commenced and conditions during observations (e.g. sea state, visibility, weather, etc.). Any sightings of marine mammals around the piling vessel would also be recorded. The MMOB would complete the relevant marine mammal recording form(s) and reporting (see **Section 2.2.1.10**).
110. There would be clear communication channels between the MMOB, the PAM Op, the ADD operator and the Piling Supervisor (see **Section 1.1.1.1**). The communication procedures would be established and agreed prior to any piling to ensure clear communication of any marine mammal observations within the monitoring area, the deployment of ADD, and when the monitoring area is clear for the piling soft-start to commence.

2.2.1.3 Passive Acoustic Monitoring

111. The use of PAM would be undertaken by trained, and dedicated PAM Ops (including at least one experienced PAM Ops) to undertake monitoring concurrently with visual observations and during periods of poor visibility and darkness prior to piling.
112. PAM Ops would be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment would be appropriate to detect all vocalising cetaceans in the monitoring area. PAM-Ops would be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all piling activities.
113. The PAM Ops would ensure that the equipment and spares are functioning correctly prior to the start of the mitigation. Hydrophones and software should be configured to detect the species relevant to the area (including harbour porpoise dolphin species and minke whale). If the PAM equipment is to be deployed from the deck of the piling vessel, a survey of the piling vessel would be conducted, prior to when deployment may be needed, to agree the best locations for deployment and monitoring. PAM Ops would assist in preparation and update of risk assessment for hydrophone deployment in collaboration with vessel personnel.
114. If required, PAM would be carried out to monitor the monitoring area:
 - During pre-piling monitoring period;
 - During ADD activation;
 - During the soft-start and ramp-up procedure; and
 - During any breaks in piling prior to piling recommencing.
115. Where possible, PAM would continue monitoring during piling to allow for any breaks in piling.
116. The PAM Ops would record and report all periods of PAM, including start and finish time of monitoring, if and when marine mammals were detected, especially in relation to when ADDs were activated and, when soft-start, ramp-up and piling was underway. The PAM Ops would provide the necessary data and information to be included in the reporting (see **Section 2.2.1.10**).
117. There would be clear communication channels between the PAM Ops, MMOB, the ADD operator and the Piling Supervisor (see **Section 1.1.1.1**).

2.2.1.4 Piling at Night / Poor Visibility

- 118. If piling is to commence in poor visibility or at night, the monitoring of the monitoring area would be undertaken by PAM as outlined in **Section 2.2.1.3**.
- 119. The deployment and activation of the ADD in poor visibility and at night would follow the same procedure as outlined in **Section 2.2.1.5**, as would the soft-start and ramp-up procedure as outlined in **Section 2.2.1.6**.
- 120. If there are any breaks in piling during poor visibility or at night, monitoring of the monitoring area would be done by PAM.

2.2.1.5 Acoustic Deterrent Device

- 121. The MZ for potential injury would be determined based on the maximum range for PTS using the impacts range from SEL_{cum} from the Project underwater noise modelling. The range of the MZ and the relative species swim speed would be used to define the duration of the ADD activation time. The maximum duration of the ADD activation time would also be determined to reduce risk of increased disturbance. Note that the required duration would be confirmed within the final MMMP post-consent.
- 122. An ADD would be activated after a pre-piling search and prior to the soft start as mitigation to reduce the risk of PTS during piling. If a marine mammal is detected in the monitoring area prior to activation of the ADD, the ADD will not be activated until the animal has left.
- 123. The type and model of ADD would be determined in the final MMMP for piling, based on the latest information and advice, and would provide sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the MZ.
- 124. The ADD would be tested prior to the pre-piling monitoring to ensure it is working correctly. If there are any technical problems with the ADD then, if required, the soft-start would be delayed until these issues are resolved. A back-up ADD would be present on board, in case there are issues with activation of the primary system.
- 125. The ADD would be positioned within the water column to ensure that sound can be emitted in all directions. The ADD would be deployed from the piling vessel in close proximity to the piling location, where it is safe to be positioned prior to the commencement of the soft-start.

- 126. For deployment of the ADD, the transducer part of the device would be lowered over the side of the deck to a water depth that is below the draft of the vessel to ensure the sound can be emitted in all directions and not dampened by the presence of the vessel. The depth for the ADD deployment would be predetermined to ensure it is below the draft of the vessel, and well above the seabed (preferably in the middle of the water column) at the piling location.
- 127. The ADD would be activated at a time so that the end of ADD activation coincides with the end of the monitoring period, immediately prior to soft-start commencing to allow marine mammals to move beyond the area of potential PTS risk.
- 128. The monitoring area would be observed by MMOb and / or PAM Ops during the ADD activation period. Once the soft-start proceeds, the ADD would be switched off.
- 129. The procedures for ADD activation for breaks in piling is outlined in **Section 2.2.1.7**. ADD would not be operated intermittently during any breaks in piling.
- 130. The ADD would be deployed from the deck of the piling vessel, with the control unit and power supply on board the piling vessel in suitable positions on deck. Prior to deployment, a survey of the piling vessel would be conducted to agree the best location and method of providing power supply and communications. ADD equipment would have sufficient cable from the power point on the vessel to be deployed in the mid-water column.
- 131. The ADD operator would maintain a detailed record of all ADD deployments and activation. These reports would include a record of all ADD start and stop times, a record of each verification of ADD activation and a record of any issues with ADD deployment and activation.

2.2.1.6 Soft-Start and Ramp-Up

- 132. Following the activation period of the ADD, the soft-start procedure would commence. The soft-start starting hammer energy would be the lowest possible starting hammer energy.
- 133. A ramp-up period would follow the soft-start, with the energy used per hammer blow gradually increasing so that if any marine mammals are in the area, despite the pre-piling activation of the ADD, they are encouraged to leave by the initial low levels of underwater noise prior to the noise reaching levels which could cause PTS.
- 134. The Project would ensure that a soft-start and ramp-up procedure for piling is conducted for a minimum of 20 minutes, as recommended by the current JNCC (2010) guidance.

135. It is proposed that each piling event would commence with the lowest possible energy for a minimum of 10 minutes (for example, at 10% of the maximum hammer energy), followed by a gradual ramp-up for at least 20 minutes up to 80% of the maximum hammer energy for all pile driving activities.
136. During the minimum 20 soft-start and the following ramp-up it is estimated that marine mammals would move at least 1.8km from the piling location (based upon a precautionary marine mammal swimming speed of 1.5m/s (Otani *et al.* 2000)). This would be greater than the maximum predicted distance for PTS from a single strike at the maximum hammer energy when combined with the used of the ADD.
137. If a marine mammal enters the monitoring area during the soft-start then, whenever possible, the piling operation should cease, or at the least the power should not be further increased until the marine mammal exits the MZ, and there is no further detection for 20 minutes.
138. The soft-start and ramp-up procedure would be undertaken for all piling operations.

2.2.1.7 Breaks in Piling

139. Monitoring of the monitoring area during any breaks in piling would be conducted by MMOB during daylight hours and suitable visibility or by PAM operators during poor visibility or at night.
140. For any breaks in piling (including breaks during the soft-start) the following mitigation is proposed, depending on the duration of the break:
 - For any breaks in piling of less than 10 minutes, piling may continue as required (i.e. as if there was no break) as long as MMOB and / or PAM operators have been in continuous watch and no marine mammals are detected within the monitoring area during the break period;
 - For any breaks in piling of more than 10 minutes but less than two hours, as long as MMOB and / or PAM operators have been in continuous watch and no marine mammals are detected within the monitoring area during the break period then piling can recommence with an altered soft-start procedure (e.g. five to six blows of the hammer at starting hammer energy) before continuing as required;
 - If marine mammals are present within the monitoring area, then the full mitigation procedure (as outlined above) would be undertaken, including 30 minute monitoring of the monitoring area by MMOB and / or PAM, ADD deployment and activation for the required time, followed by the soft-start and ramp-up procedure (for a minimum of 20 minutes) starting at the lowest practical hammer energy;

- For any breaks in piling of more than two hours then the full mitigation procedure (as outlined above) is required, including 30 minute monitoring of the monitoring area by MMOB and / or PAM operators, ADD deployment and activation for the required time, followed by the soft-start and ramp-up procedure; and
- If monitoring was conducted during piling prior to, and during, any breaks and the monitoring area has been confirmed as having no marine mammals present, then it may be possible to commence the soft-start immediately which would be determined by the MMOB. The soft-start and ramp-up procedure would be for a minimum of 20 minutes (as outlined in the JNCC guidance).

2.2.1.8 Mitigation for Multiple Pile Locations

141. For multiple pile locations, the mitigation as set out above for single pile locations would apply and be undertaken at each pile location. The potentially required ADD activation times may be increased to cover an increase in the potential impact ranges, however, this would be confirmed for the multiple pile scenario in the final MMMP, and once, the final pile design, and the potential for multiple locations at once, is known.

2.2.1.9 Additional Mitigation Measures

142. Once the project design has been confirmed, additional mitigation and / or management options would be confirmed in the final MMMP and through consultation with the relevant SNCBs. The final MMMP will be based on the final design and will consider new and emerging technologies, guidance and advice that may have emerged before construction. The final MMMP will deliver noise reductions through the use of primary (through project design) and / or secondary noise reduction methods (such as Noise Abatement Systems (NAS)). These measures may include but are not limited to;
- Noise Abatement Systems; and
 - Scheduling of pile driving.

2.2.1.9.1. Different Foundation Types and Installation Methods

2.2.1.9.2. Noise Abatement Systems

143. It is understood that the current position of the MMO and SNCBs on the use of NAS at OWFs is that developers must employ best endeavours in the use of NAS for all piling activities from 2025 onwards. NAS will therefore be considered in the DCO application, and if required, will be included in the final MMMP post-consent, once the final design is confirmed. The most up to date guidance at the time of submission on the use of NAS will be followed.
144. NAS systems include big and small bubble curtains, which have been extensively tested and have been recorded from German wind farms to reduce sounds from impact piling to a minus 15dB and 20dB. Bubble curtains are deployed around the piling event producing a continuous flow of air through hoses or perforated tubes from a compressor onboard a vessel, to cushion in the sound, preventing propagation of sound.
145. Other methods of NAS include resonators of sound, consisting of an array of resonating units that are deployed around the pile to absorb the emitted sound. Unlike with bubble curtains which are built of ascending air bubbles from a nozzle hose laid at the seafloor, there are a variety of different ways to build resonators. One is using hydro sound dampers, using gas filled containers (balloons) integrated into a net, deployed around the piling event to prevent the propagation of sounds. Other methods include pile casing systems, that enclose the pile with reflective material during the piling activity to keep the sound emitted by the pile trapped within the casing. Casings range from flexible pile sleeves made of different fabrics to hollow steel tubes.

2.2.1.10 Communication

146. The final MMMP for piling would detail the communication protocol to ensure that all marine mammal mitigation measures, including any delays in commencing piling due to marine mammals being present in the area, are successfully undertaken for all piling activity.
147. The final MMMP for piling would also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken for all piling activity. This would be developed based on the mitigation measures and personnel required (e.g. ADD operators, MMOs, PAM operators, ELO, Piling Supervisor / Offshore Installation Manager) with the titles and responsibilities being refined depending on the contractual agreement.

2.2.1.11 Reporting

148. Reports detailing the piling activity and mitigation measures would be kept for all piling activity. This would include, but not necessarily be limited to:
- A record of piling operations detailing date, location, times (including soft-starts and ramp-up) and any technical or other issues for each pile;
 - A record of mitigation measures such as ADD deployment and activation, detailing date, location, times and any operational issues;
 - A record of all occasions when piling occurred, including details of the activities used to ensure the MZ is established and any occasions when piling activity was delayed or stopped due to presence of marine mammals;
 - Any relevant details on the efficiency of the marine mammal exclusion methodology;
 - A record of marine mammal observations, conditions, description of any marine mammal sightings and any actions taken; and
 - Details of any problems encountered during the piling process including instances of non-compliance with the agreed piling and / or mitigation plan.
149. All licenced activities would be listed (including the use of ADDs) on the Marine Noise Registry and a close out report submitted no later than 12 weeks after the completion of the licenced activities.
150. The reporting schedule is to be agreed with the MMO post-consent. Any final report would include information, such as data collected during piling operations, details of ADD deployment and / or other mitigation measures, a detailed description of any technical problems encountered and what, if any, actions were taken. The report would also discuss the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future construction projects.

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List of Tables

Table 1-1 Key Relevant Parameters	9
Table 1-2 Consultation Responses on Marine Mammal Mitigation	11

List of Acronyms

Acronym	Definition
ADD	Acoustic Deterrent Device
dB	Decibel
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
dML	Deemed Marine Licence
ELO	Environmental Liaison Officer
EOD	Explosive Ordnance Disposal
ES	Environmental Statement
ETG	Expert Topic Group
JNCC	Joint Nature and Conservation Committee
kJ	Kilojoules

OUTLINE MARINE MAMMAL MITIGATION PLAN

Acronym	Definition
km	Kilometre
km ²	Kilometre squared
LAT	Lowest Astronomical Tide
m	Metre
m/s	Metres per second
ML	Marine Licence
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Management Organisation
MMOb	Marine Mammal Observer
MZ	Mitigation Zone
NAS	Noise Abatement Systems
NPL	National Physical Laboratory
MMMP	Marine Mammal Mitigation Plan
PAM	Passive Acoustic Monitoring
PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift
SEL	Sound Exposure Level
SEL _{cum}	Cumulative Sound Exposure Level
SNCB	Statutory Nature Conservation Body
SPL	Sound Pressure Level
SPL _{peak}	Peak Sound Pressure Level
TNT	Trinitrotoluene
UK	United Kingdom
UXO	Unexploded Ordnance