MONA OFFSHORE WIND PROJECT

Outline Marine Mammal Mitigation Protocol

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Image of an offshore wind farm

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Glossary

Term	Meaning
Applicant	Mona Offshore Wind Limited.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Environmental Statement	The document presenting the results of the Environmental Impact Assessment (EIA) process for the Mona Offshore Wind Project.
Habitats Directive	The Habitats Directive is the short name for the European Union Council Directive 92/93/EEC on the conservation of natural habitats and of wild fauna and flora. The Directive led to the establishment of European sites and set out how they should be protected it also extended to other topics such as European protected species.
Marine licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. Section 149A of the Planning Act 2008 allows an applicant for a DCO to apply for 'deemed marine licences' as part of the DCO process. In addition, licensable activities within 12nm of the Welsh coast require a separate marine licence from Natural Resource Wales (NRW).
Maximum Design Scenario (MDS)	The scenario within the design envelope with the potential to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor.
Mona Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, offshore export cables and offshore substation platforms (OSPs) forming part of the Mona Offshore Wind Project will be located.
Mona Offshore Cable Corridor and Access Areas	The corridor located between the Mona Array Area and the landfall up to Mean High Water Springs (MHWS), in which the offshore export cables will be located and in which the intertidal access areas are located,
Mona Offshore Wind Project PEIR	The Mona Offshore Wind Project PEIR that was submitted to The Planning Inspectorate (on behalf of the Secretary of State) and Natural Resource Wales (NRW) for the Mona Offshore Wind Project.
National Policy Statement (NPS)	The current national policy statements published by the Department for Energy Security & Net Zero in 2023.
Offshore Substation Platform (OSP)	The offshore substation platforms located within the Mona Array Area will transform the electricity generated by the wind turbines to a higher voltage allowing the power to be efficiently transmitted to shore.
Outline Marine Mammal Mitigation Protocol (MMMP)	The protocol setting out the appropriate measures to be adopted as part of the Mona Offshore Wind Project relevant to offshore activities that are likely to produce underwater sound levels capable of potentially causing injury or disturbance to marine mammals.
Pre-construction site investigation surveys	Pre-construction geophysical and/or geotechnical surveys undertaken offshore and, or onshore to inform, amongst other things, the final design of the Mona Offshore Wind Project.
Statutory consultee	Organisations that are required to be consulted by an applicant pursuant to the Planning Act 2008 in relation to an application for development consent. Not all consultees will be statutory consultees (see non-statutory consultee definition).
Underwater sound	Sound waves made underwater.
Wind turbines	The wind turbine generators, including the tower, nacelle and rotor.

Acronyms

Acronym	Description
ADD	Acoustic Deterrent Devices
DCO	Development Consent Order
dML	Deemed Marine Licence
EIA	Environmental Impact Assessment
EOD	Explosive Ordnance Disposal
EPS	European Protected Species
HF	High Frequency
IEMA	Institute of Environmental Management and Assessment
ICUN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
MBES	Multi-Beam Echo-Sounder
MDS	Maximum Design Scenario
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observer
NAS	Noise Abatement Systems
NEQ	Net Explosive Quantity
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OSP	Offshore Substation Platforms
OSPAR	Convention for the Protection of the Marine Environment of the North East Atlantic
PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivores in Water
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift
SBES	Single Beam Echosounder
SBP	Sub-Bottom Profiler
SEL_{cum}	Cumulative Sound Exposure Level
SNCB	Statutory Nature Conservation Bodies
SPL_{pk}	Peak Sound Pressure Level
SSS	Sidescan Sonar

Acronym	Description
TWT	The Wildlife Trust
UHRS	Ultra High Resolution Seismic
UWSMS	Underwater Sound Management Strategy
UXO	Unexploded Ordnance
VHF	Very High Frequency

Units

Unit	Description
%	Percentage
µPa	Micro Pascal (10-6)
dB	Decibel
Hz	Hertz
m	Metre
m/s	Metres per second
MW	Megawatt

1 Outline Marine Mammal Mitigation Protocol

1.1 Introduction

1.1.1 Background

1.1.1.1 Mona Offshore Wind Limited (the Applicant), a joint venture of bp Alternative Energy Investments Ltd (hereafter referred to as bp) and Energie Baden-Württemberg AG (hereafter referred to as EnBW), is developing the Mona Offshore Wind Project, a proposed wind farm located in the east Irish Sea (Figure 1.1).

1.1.1.2 The Mona Offshore Wind Project will consist of up to 96 wind turbines and four Offshore Substation Platforms (OSPs). The final capacity of the Mona Offshore Wind Project will be determined based on available technology and constrained by the design envelope presented in Volume 1, Chapter 3: Project description of the Environmental Statement (Document Reference F1.3). The offshore infrastructure will also include up to 360 km of offshore export cables, 50 km of interconnector cables and 325 km of inter-array cables.

1.1.1.3 A marine licence is required before carrying out any licensable marine activities under the Marine and Coastal Access Act 2009. The marine licence (ML) for activities located in Welsh offshore waters will be deemed under the Development Consent Order (DCO). The deemed ML (dML) will cover works related to the offshore wind farm generation infrastructure (wind turbines, OSPs, inter-array cables and interconnector cables). A separate, standalone ML will be required for activities within 12 nautical miles (nm) of the Welsh coast. The standalone ML will cover works associated to the offshore export cables, interconnector cables, OSPs, Mona Offshore Cable Corridor and Access Areas. The OSPs and interconnector cables are included in both marine licences as it has not yet been determined whether they would be generation or transmission infrastructure. This outline Marine mammal mitigation protocol (MMMP) is applicable to both the generation and transmission infrastructure. Therefore, it is secured under Schedule 14 Part 2 of the DCO and is expected to also be secured within the standalone ML, as presented in the Marine Licence principles document (Document Reference J9) submitted with the application for consent.

1.1.1.4 The Applicant intends to commence construction of the Mona Offshore Wind Project from 2026 and for it to be fully operational by 2030 in order to help meet UK and Welsh Government renewable energy targets. The Mona Offshore Wind Project will have a lifetime of 35 years.

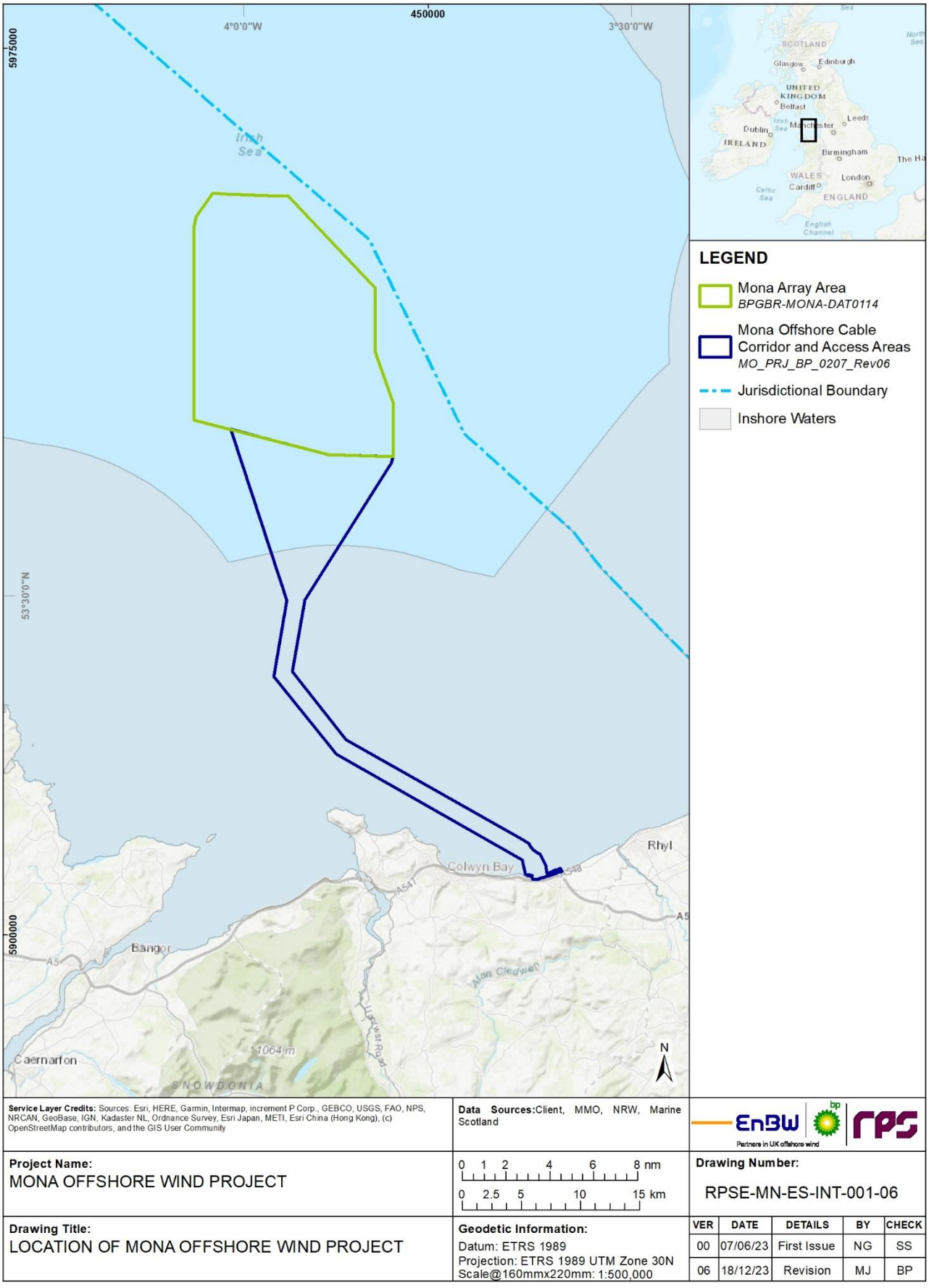

Figure 1.1: Location of the Mona Offshore Wind Project.

1.1.2 Purpose of the Outline Marine Mammal Mitigation Protocol

1.1.2.1 During the Environmental Impact Assessment (EIA) process, the Applicant has developed a range of measures adopted as a part of the project to reduce or eliminate the risk of injurious effects of underwater sound due to piling (section 1.4.2), Unexploded Ordnance (UXO) clearance (section 1.4.3) and geophysical surveys (section 1.4.4) on marine mammals. The purpose of the MMMP is to present the measures proposed to reduce or eliminate the risk of auditory injury in terms of Permanent Threshold Shift (PTS) to marine mammals during pre-construction and construction phases of the Mona Offshore Wind Project. At this stage (Application) an Outline MMMP (Document Reference J21) has been produced and a Final MMMP will be developed post-consent, in consultation with Natural Resources Wales (NRW) and Statutory Nature Conservation Bodies (SNCBs), in consideration of any refinements to the Mona Offshore Wind Project design. The Applicant's commitment to the Final MMMP is secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

1.1.2.2 Information presented in this Outline MMMP is based on Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4) and focuses on the measures adopted as a part of the Mona Offshore Wind Project in line with recent guidance (Joint Nature Conservation Committee (JNCC), 2017, JNCC, 2010a, JNCC, 2010b).

1.1.3 Linkage with the Underwater sound management strategy

1.1.3.1 The MMMP forms an annex to the Underwater sound management strategy (UWSMS) and is the consent plan focussing solely on the primary and tertiary measures required to mitigate the effects of injury to marine mammals. The role and purpose of the MMMP and UWSMS are detailed in Table 1.1.

1.1.3.2 The Outline Underwater sound management strategy (Document Reference J16) is included with the application for consent, and sets out an account of responsibilities, a summary of consultation and measures adopted as a part of the Mona Offshore Wind Project alongside the overview of the steps to be undertaken by the Applicant post-consent to reduce the magnitude of impacts on marine mammals and fish (including further mitigation options (referred to as 'secondary mitigation' in Institute of Environmental Management and Assessment (IEMA) guidance 2016) if necessary). The final UWSMS will be produced post-consent in consultation with the licensing authority and SNCBs. It will set out the detailed Mona Offshore Wind Project design prior to construction and the review of any additional potential management measures required to ensure any residual effects (considering both injury and disturbance) from the project are reduced to a non-significant level.

Table 1.1: Role and purpose of the UWSMS and linkage with the MMMP.

Document	Purpose	Where it is secured
Final MMMP, with an Outline MMMP included as part of the application (Document Reference J21)	Details the range of primary and tertiary measures adopted as part of the project to reduce or eliminate the risk of auditory injury effects of underwater sound (due to piling, UXO clearance and geophysical survey) during pre-construction and construction phases of the Mona Offshore Wind Project on marine mammals.	Final MMMP secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be

Document	Purpose	Where it is secured
		secured within the standalone NRW marine licence.
Final UWSMS, with an Outline UWSMS included as part of the application (Document Reference J21)	The UWSMS provides a strategy to reduce the magnitude of impacts from elevated underwater sound from the Mona Offshore Wind Project, such that there is no significant effect on fish or marine mammals. The UWSMS is the overarching document considering both injury and disturbance to marine mammals and fish receptors from all activities assessed within the EIA where there is a potential effect of elevated underwater sound. The Outline UWSMS sets out the process for investigating further mitigation options (referred to as 'secondary mitigation' in IEMA guidance 2016) to manage underwater sound levels to reduce the magnitude for the project alone if required. With respect to injury to marine mammals the requirement for further mitigation options is considered where there remains a residual risk of a significant effect after implementation of the measures adopted in the MMMP. The Final UWSMS will be developed in consultation with the licensing authority and SNCBs.	Final UWSMS secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

1.1.4 Measures adopted as part of the Mona Offshore Wind Project

1.1.4.1 The measures adopted as a part of the project relevant to potential injurious effects of underwater sound due to piling, UXO clearance and geophysical surveys on marine mammals are described in Table 1.2. These can be referred to as measures included as a part of the Mona Offshore Wind Project design (primary measures) and measures required to meet legislative requirements or adopted industry practice (tertiary measures). Whilst the Outline MMMP focuses on tertiary mitigation in line with industry standard guidance, primary measures are included in this document as these are required to be implemented as part of the project design and aim to reduce the impact of auditory injury from elevated underwater sound on marine mammals.

Refinements from PEIR to Application

1.1.4.2 It is worth highlighting that the Mona Offshore Wind Project design has already been refined from the Preliminary Environmental Information Report (PEIR) to the Environmental Statement and includes a reduction in the number of wind turbines from 107 to 96. The number of wind turbines has been reduced by approximately 10% thereby reducing the number of foundations that require piling and therefore the magnitude of impacts on marine mammal species arising from underwater sound from piling.

1.1.4.3 Monopile foundations (as presented in the PEIR) have also been removed from the Project Design Envelope (PDE), and only pin piles have been taken forward to the Environmental Statement as the Maximum Design Scenario (MDS). As such, the maximum hammer of 5,500 kJ (presented in the PEIR for monopiles) has reduced to a maximum hammer energy of 4,400 kJ for the Environmental Statement. A proportion of hammer energy is converted into waterborne acoustic energy going into the water column and large hammer energies may result in increased peak sound levels received by marine mammals. As such, the removal of monopile foundations from the

PDE and the reduction in maximum hammer energy has reduced the range at which instantaneous injury could occur to marine mammals from received peak Sound Pressure Levels (SPL_{pk}). For cumulative sound exposure level (SEL_{cum}), ranges for Very High Frequency (VHF) species such as harbour porpoise also reduced, but for Low Frequency (LF) species such as minke whale ranges have increased due to the higher strike rate in the same overall piling duration in the PDE for the Environmental Statement.

Table 1.2: Measures adopted as part of the Mona Offshore Wind Project.

Mitigation Measure	Description
Primary measures	
A limit on the maximum hammer energy used during concurrent piling at 3,000 kJ and during the single event piling at 4,400 kJ.	The project has committed to piling concurrently only at locations where a maximum hammer energy of 3,000 kJ will be used. At locations where a 4,400 kJ hammer may be required piling will occur as a single event. This will minimise the likelihood of injury to marine mammals in the immediate vicinity of piling operations, by reducing the injury ranges and spatial area of ensonification during concurrent piling.
Maximum separation limit of 15 km for concurrent piling.	Commitments made around maximum separation during concurrent piling will minimise the likelihood of disturbance to marine mammal species in the immediate vicinity of piling operations, by limiting the ensonified area during concurrent piling. Where piling occurs concurrently a maximum separation distance of 15 km is used to limit received sound levels by reducing the area of overlapping sound emission from each of the piling activities.
Minimum separation limit of 1.4 km for concurrent piling.	Commitments made around minimum separation during concurrent piling will minimise the likelihood of injury to marine mammal species in the immediate vicinity of piling operations, by limiting the spatial overlap of areas of ensonification during concurrent piling. Where piling occurs concurrently, a minimum separation distance of 1.4 km is used to minimise the potential for additive effects due to direct overlap of concurrent piling.
Implementation of soft start (for piling, UXO, geophysical surveys) and ramp up procedure (for piling).	During piling operations at each location, an initiation stage and soft start will be implemented. Low hammer energy with a low strike rate (i.e. strikes per minute) will be used initially at the beginning of piling sequence, followed by lower hammer energies at a higher strike rate before energy input is 'ramped up' (increased) over time to required higher levels (included as part of JNCC guidelines (JNCC (2010a)). For high order detonation of UXO, soft start will be undertaken using a sequence of small explosive charges detonated at specific time intervals allowing marine mammals to move away from the mitigation zone prior to the detonation of the UXO. For geophysical surveys, soft start will be undertaken where possible for sonar-like and impulsive sources.
Implementation of a mitigation hierarchy with regard to UXO clearance that follows: • Avoid UXO • Clear UXO with low order techniques • Clear UXO with high order techniques. Low order techniques or avoidance of confirmed UXO are not always possible	Low order techniques generate less underwater sound than high order techniques and therefore present a lower risk to sound-sensitive receptors such as marine mammals during UXO clearance. Noting the position statement from statutory authorities on UXO clearance that low order alternatives should be prioritised when clearing UXO (Defra, 2022), the option to clear UXOs with low order techniques has been considered as a potential primary mitigation measure as part of this assessment. Low order techniques or avoidance of confirmed UXO are not always possible and are dependent upon the individual situations surrounding each UXO.

Mitigation Measure	Description
and are dependent upon the individual situations surrounding each UXO.	Given that it is possible that high order detonation may be used, this Outline MMMP includes tailored mitigation dependent on the size of UXO requiring clearance (e.g. number of soft starts, duration of soft start procedure) to reduce the likelihood of injury from UXO (see section 1.4.3 for more details). A range of UXO sizes from 25 kg to 907 kg (absolute maximum) with 130 kg the most likely (common) maximum has been included.
Tertiary measures	
Development of and adherence to an UWSMS that includes consideration of Noise Abatement Systems (NAS) as part of mitigation options, which will be developed in accordance with the Outline UWSMS (Document Reference J21), will be made as part of a stepped strategy post consent and following the mitigation hierarchy - avoid, reduce, mitigate	A commitment to considering the use of NAS as part of further mitigation options in the UWSMS if required (i.e. there remains a residual significant effect even with the inclusion of primary and tertiary measures adopted). Consequently, if NAS is required as an option, a detailed exploration of available technologies will be undertaken and information presented in the final UWSMS (Document Reference J16) to demonstrate how such technology would contribute to the reduction in underwater sound from piling or UXO clearance.

1.2 Key species

1.2.1 Overview

1.2.1.1 Data gathered through a desktop review and site-specific survey data (as detailed in Volume 6, Annex 4.1: Marine mammal technical report (Document Reference F6.4.1) and Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4)) found that that the Irish Sea supports a number of different marine mammal species with internationally important populations of certain species occurring within the regional marine mammal study area as well as the vicinity of the Mona Offshore Wind Project.

1.2.1.2 The analysis considered data collected during the aerial digital surveys, which were carried out monthly between March 2020 and February 2022 and covered the Mona Array Area with a buffer of between 7 km and 16.5 km. For a full list of reviewed studies and datasets refer to Volume 6, Annex 4.1: Marine mammal technical report of the Environmental Statement (Document Reference F6.4.1).

1.2.1.3 Key marine mammal species identified within the regional marine mammal study area include harbour porpoise, bottlenose dolphin, minke whale, short-beaked common dolphin, Risso's dolphin, grey seal and harbour seal. Table 1.3 provides a brief description of the key species distribution. To provide context for the summary of potential impacts presented in section 1.5, Table 1.3 also includes classification of each marine mammal species into functional marine mammal hearing groups based on Southall *et al.* (2019) terminology.

Table 1.3: Summary of cetacean and pinniped species found in the regional marine mammal study area and their hearing groups. Sources: Reid *et al.* (2003), O'Brien *et al.* (2009), Baines and Evans (2012), Waggitt *et al.* (2020), Carter *et al.* (2022) and Southall *et al.* (2019).

Species	Description of Species Distribution	Hearing Group	Conservation status
Cetaceans			
Harbour porpoise *Phocoena phocoena*	Widespread in cold and temperate northwest European shelf waters, and abundant throughout the Irish Sea. Common inshore species found in high densities in the Irish Sea. Highest relative abundances in the western half of the central Irish Sea. High predicted relative densities in both winter and summer in the Irish Sea.	VHF	Annex II species protected under the European Council directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC) (Habitats Directive) within a European Marine Site, European Protected Species (EPS), Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) protected species, International Union for Conservation of Nature (IUCN) Red List Least Concern.
Bottlenose dolphin *Tursiops truncatus*	Near-global distribution, widely distributed in the North Atlantic and occurs year-round throughout the Irish Sea near-shore. Predominately coastal distribution (though low densities have been recorded offshore). Concentrations of resident populations in Cardigan Bay and off the coast of Co. Wexford. Seasonal differences in dispersion have been noted (e.g. dolphins in summer occurring mainly in small groups near the coast, centred upon Cardigan Bay, dispersing more widely and generally northwards, where they may form very large groups in winter).	High Frequency (HF) cetacean	Annex II species protected under the Habitats Directive within a European Marine Site, EPS, IUCN Red List Least Concern.
Risso's dolphin *Grampus griseus*	Worldwide distribution, and in northwest Europe appears to be continental shelf species. Clusters regularly seen in the Irish Sea, with a relatively localised distribution, forming a wide band running SW-NE that encompasses west Pembrokeshire, the western end of the Llŷn Peninsula and Anglesey in Wales, the southeast coast of Ireland in the west, and waters around the Isle of Man in the north.	HF cetacean	Annex II species protected under the Habitats Directive within a European Marine Site, EPS, IUCN Red List Least Concern.
Short-beaked common dolphin *Delphinus delphis*	Most numerous offshore cetacean species in the temperate northeast Atlantic. Widespread and abundant, centred upon the Celtic Deep at the southern end of the Irish Sea, where water depths range from 50 to 150 m. High-density area extends eastwards towards the coast and islands of west Pembrokeshire. Elsewhere in the Irish Sea, the species occurs at low densities mainly offshore, in a central band that	HF cetacean	Annex II species protected under the Habitats Directive within a European Marine Site, EPS, IUCN Red List Least Concern.

Species	Description of Species Distribution	Hearing Group	Conservation status
	extends northwards towards the Isle of Man.		
Minke whale *Balaenoptera acutorostrata*	Ranges widely and can be observed throughout the north of the North Sea but is more localised in the Irish Sea.	LF cetacean	Annex II species protected under the Habitats Directive within a European Marine Site, EPS, IUCN Red List Least Concern.
Pinnipeds			
Grey seal *Halichoerus grypus*	Restricted to North Atlantic but found all around the UK, with breeding populations around the coast of the Irish Sea. High counts along east of Northern Ireland, south-west of Isle of man, and north coast of Wales and River Dee. At-sea seal distribution maps show high density areas in the southeast of the Irish Sea, and along the east coast of Ireland and west Isle of Man.	Phocid Carnivores in Water (PCW)	Annex II species protected under Habitats Directive within a European Marine Site, IUCN Red List Least Concern
Harbour seal *Phoca vitulina*	Hauls out on coasts of Scotland and Northern Ireland, with high haul-out counts on the east of Northern Ireland. At-sea seal distribution maps show high density areas on the east coast of Northern Ireland.	PCW	Annex II species protected under Habitats Directive within a European Marine Site, IUCN Red List Least Concern.

1.3 Legislation

1.3.1.1 The Mona Offshore Wind Project will be located in Welsh offshore waters (beyond 12 nautical miles (nm) from the Welsh coast) and inshore waters, with the onshore infrastructure located wholly within Wales. As set out in Volume 1, Chapter 1: Introduction of the Environmental Statement (Document Reference F1.1), since the Mona Offshore Wind Project is an offshore generating station with a capacity of greater than 350 MW located in Welsh waters, it is a Nationally Significant Infrastructure Project (NSIP) as defined by Section 15(3) of the Planning Act 2008 (as amended) (the 2008 Act). As such, there is a requirement to submit an application for a DCO to the Planning Inspectorate to be decided by the Secretary of State for the Department for Energy Security and Net Zero. Consideration of the National Policy Statements (NPSs), the North West Inshore and North West Offshore Coast Marine Plans and Planning Policy Wales relevant to marine mammals and the Mona Offshore Wind Project is provided in full detail in Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4).

1.3.1.2 The UK has a responsibility to protect all whales, dolphins and porpoises, derived from legal requirements under the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (hereafter referred to as the Habitats Directive), as well as various obligations under international law. The Habitats Directive is transposed into UK law by the Habitats Regulations, which includes The Conservation of Habitats and Species Regulations 2017 (covering England, Wales and Scotland for reserved matters), The Conservation of Offshore Marine Habitats and Species Regulations 2017, The Conservation (Natural Habitats,

&c.) (Scotland) Regulations and The Conservation (Natural Habitats, etc.) (Northern Ireland) Regulations 1995. For the Isle of Man, the Wildlife Act 1990 is the primary wildlife protection legislation and sets out schedules of Manx species of animal and plant that are protected by law from injury or disturbance.

1.3.1.3 Cetaceans in waters more than 12 nautical miles from land are protected under the Conservation of Offshore Marine Habitats and Species Regulations 2017.

1.4 Injury to marine mammals from elevated underwater sound

1.4.1 Overview

1.4.1.1 This section provides a summary of the impacts from the Mona Offshore Wind Project that may result in the injurious effect on marine mammals. Please note that injury ranges presented in this section do not include application of tertiary mitigation which is discussed in more detail in sections 1.7 to 1.9.

1.4.1.2 Marine mammals are at risk of experiencing auditory injury from elevated underwater sound as a result of:

- Piling during the construction phase of the Mona Offshore Wind Project (section 1.4.2)
- UXO clearance during the pre-construction phase of the Mona Offshore Wind Project (section 1.4.3)
- Geophysical surveys during the construction phase of the Mona Offshore Wind Project (section 1.4.4).

1.4.2 Piling

1.4.2.1 Pile driving during the construction phase of the Mona Offshore Wind Project has the potential to result in elevated levels of underwater sound that are detectable by marine mammals above background levels and could result in auditory injury.

Maximum design scenario

1.4.2.2 For the piling across the Mona Offshore Wind Project, MDS (see Volume 1, Chapter 5: Environmental Impact Assessment methodology of the Environmental Statement for detail on the MDS approach (Document Reference F1.5)) for marine mammals includes installation of:

- Up to 64 wind turbine four-legged jacket foundations with a total of 256 pin piles
- Up to 32 wind turbine gravity based foundations, up to 10 of which could require piling for ground strengthening, with a total of 150 ground strengthening pin piles
- Up to four OSPs with four-legged jacket foundations with a total of 48 pin piles.

1.4.2.3 The installation of pin piles at wind turbine jacket foundations assumes (as the MDS) the application of a maximum hammer energy of 4,400 kJ at up to 16 locations and 3,000 kJ at up to 48 locations. The maximum hammer energy required to install ground strengthening pin piles at the wind turbine gravity based foundations is 3,000 kJ at all locations. It is anticipated that installation of all four OSPs will require a maximum hammer energy of 4,400 kJ.

1.4.2.4 The project has committed through this Outline MMMP (secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the

standalone NRW marine licence) to piling concurrently only at locations where a maximum hammer energy of 3,000 kJ will be used. At locations where a 4,400 kJ hammer may be required piling will occur as a single event.

1.4.2.5 The MDS parameters for piling at wind turbines and OSPs for marine mammals are presented in Table 1.4.

Table 1.4: MDS for piling.

Parameter	Wind Turbines		OSPs (Jacket Foundations)
	Jacket Foundation	Gravity Based Foundation	
Number of foundations	64	32	4
Number of piles	256	150	48
Maximum hammer energy	4,400 kJ at 16 locations 3,000 kJ at 48 locations	3,000 kJ at all locations	4,400 kJ at all locations
Maximum pile diameter	3.8 m	4 m	3.5 m
Total number of piling days	64	37.5	12

Summary of the assessment presented in the Environmental Statement

1.4.2.6 For full details of the piling injury ranges see Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4). The dual metric approach has been used in the impact assessment of injury, considering both SPL_{pk} (i.e. un-weighted) and marine mammal hearing-weighted SEL_{cum}, with exceedance of either used as an indication of potential impact, and the maximum used to define the mitigation zone. It is considered that for piling, with respect to the SPL_{pk} metric, the initiation hammer energy is the most relevant period, as this is when animals may potentially experience injury from underwater sound emitted by the initial strike of the hammer, after which point it is assumed that they will move away from the sound source.

1.4.2.7 The maximum range of injury based on SPL_{pk} metric across all species was predicted for harbour porpoise at 662 m at full hammer of 4,400 kJ (Table 1.5). At hammer initiation energy, harbour porpoise may experience PTS out to a maximum range of 136 m. For other species, injury (PTS) ranges at hammer initiation energy are below 30 m or not exceeded.

Table 1.5: Summary of SPL_{pk} PTS injury ranges and areas of effect for marine mammals for single pin pile installation (N/E = threshold not exceeded).

Species (hearing group)	Threshold (Unweighted Peak)	Hammer energy level	Hammer energy/Range of effect (m)	
			3,000 kJ	4,400 kJ
Harbour porpoise (VHF)	202 dB re 1 µPa	Initiation	136	136
		Maximum hammer energy	525	662
	230 dB re 1 µPa	Initiation	N/E	N/E

Species (hearing group)	Threshold (Unweighted Peak)	Hammer energy level	Hammer energy/Range of effect (m)	
			3,000 kJ	4,400 kJ
Bottlenose dolphin, Short-beaked common dolphin, Risso's dolphin (HF)		Maximum hammer energy	33	41
Minke whale (LF)	219 dB re 1 µPa	Initiation	25	25
		Maximum hammer energy	98	123
Grey seal and harbour seal	218 dB re 1 µPa	Initiation	28	28
		Maximum hammer energy	108	136

1.4.2.8 Considering exposure to sound over time, using the SEL_{cum} metric, the risk of PTS may occur out to a maximum range of 7,420 m, predicted for minke whale, assuming single piling at a hammer energy of 4,400 kJ (Table 1.6). Modelling of consecutive piling predicted a slightly larger injury range (7,520 m) although noting that this is considered unrealistic as it assumes no breaks in piling. For all other species and at all scenarios, injury thresholds were not exceeded (Table 1.6).

Table 1.6: Summary of SEL_{cum} PTS injury ranges and areas of effect for marine mammals for pin pile installation (4,400 kJ and 3,000 kJ) (N/E = threshold not exceeded).

Species (hearing group)	Threshold (SEL weighted)	Scenario	Hammer energy	Range of effect (m)
Harbour porpoise (VHF)	155 dB re 1 µPa²s	Single	4,400 kJ	N/E
			3,000 kJ	N/E
		Concurrent	3,000 kJ + 3,000 kJ	N/E
		Consecutive	4,400 kJ	N/E
			3,000 kJ	N/E
Bottlenose dolphin, Short-beaked common dolphin, Risso's dolphin (HF)	185 dB re 1 µPa²s	Single	4,400 kJ	N/E
			3,000 kJ	N/E
		Concurrent	3,000 kJ + 3,000 kJ	N/E
		Consecutive	4,400 kJ	N/E
			3,000 kJ	N/E
Minke whale (LF)	183 dB re 1 µPa²s	Single	4,400 kJ	7,420
			3,000 kJ	4,230
		Concurrent	3,000 kJ + 3,000 kJ	5,710
		Consecutive	4,400 kJ	7,520

Species (hearing group)	Threshold (SEL weighted)	Scenario	Hammer energy	Range of effect (m)
			3,000 kJ	4,290
Grey seal and harbour seal (PCW)	185 dB re 1 μPa^2s	Single	4,400 kJ	N/E
			3,000 kJ	N/E
		Concurrent	3,000 kJ + 3,000 kJ	N/E
		Consecutive	4,400 kJ	N/E
			3,000 kJ	N/E

1.4.2.9 It should be noted that the injury ranges estimated for minke whale based on the SEL_{cum} metric should be interpreted with caution, as a number of conservative assumptions were adopted in the underwater sound model that resulted in a precautionary assessment. One of the assumptions is that the soft start procedure does not allow for short pauses in piling (e.g. for realignment) and therefore the modelled SEL_{cum} is likely to be an overestimate since, in reality, these pauses will reduce the sound exposure that animals experience whilst moving away. Additionally, the use of the SEL_{cum} metric is described as an equal energy rule where exposures are assumed to produce the same sound-induced threshold shift regardless of how the energy is distributed over time. This means that for intermittent sound, such as piling, the equal-energy rule overestimates the effects since the quiet periods between sound exposures will allow some recovery of hearing compared to continuous sound. The underwater sound modelling also assumes that the sound keeps its impulsive character, regardless of the distance to the sound source when in reality, pulsed sound loses its impulsive properties while propagating away from the sound source. For more details refer to Volume 5, Annex 3.1: Underwater sound technical report of the Environmental Statement (Document Reference F5.3.1).

1.4.3 UXO clearance

1.4.3.1 The clearance of UXO prior to commencement of construction has the potential to generate high peak sound pressures and is considered a high energy, impulsive sound source with a potential to cause injury to marine mammals. The Applicant has committed to implementation of a mitigation hierarchy with regard to UXO clearance that follows:

- Avoid UXO
- Clear UXO with low order techniques
- Clear UXO with high order techniques.

1.4.3.2 Therefore, where clearance of UXO is required (i.e. avoidance is not possible) the use of low order clearance will be adopted where feasible and therefore clearance of UXO using low order techniques has been considered as a potential primary mitigation measure (Table 1.2). However low order techniques or avoidance of confirmed UXO are not always possible and are dependent upon the individual situations surrounding each UXO.

1.4.3.3 Given that it is possible that high order detonation may be used where low order is not possible, this document includes mitigation to reduce the risk of injury from high order

UXO clearance as the MDS (modelling a range of UXO sizes from 25 kg to 907 kg as the absolute maximum, with 130 kg as the most likely 'common' maximum).

1.4.3.4 If the measures in the Final MMMP do not fully mitigate clearance of UXOs, additional secondary mitigation measures may be required and will be detailed in the Final UWSMS. An Outline UWSMS submitted with the application (Document Reference J16) sets out the process for investigating further mitigation options to manage underwater sound levels to reduce the magnitude for the project alone if required.

1.4.3.5 Post consent more information on the size, type and condition of potential UXOs will be available (e.g. following pre-construction site investigation surveys) and a more detailed assessment of mitigation will be undertaken post-consent to inform the final MMMP.

Maximum design scenario

1.4.3.6 Low order techniques generate less underwater sound than high order techniques and therefore present a lower risk to sound-sensitive receptors such as marine mammals during UXO clearance. However, given that UXO clearance may involve high order detonation (where low order is not possible), the measures adopted as a part of the project presented in this Outline MMMP focus on high order clearance of a range of UXO sizes (from 25 kg to 907 kg as the absolute maximum, with 130 kg as the most likely "common" maximum). The MDS parameters for UXO clearance are presented in Table 1.7.

1.4.3.7 It is anticipated that up to 22 UXOs within the Mona Array Area and Mona Offshore Cable Corridor and Access Areas are to be cleared. The absolute maximum UXO size is assumed to be 907 kg, the most likely maximum size is 130 kg and the smallest UXO size is 25 kg (Table 1.7), and all sizes have been assessed in the Environmental Statement.

1.4.3.8 If applied, a low order clearance donor charge of 0.08 kg is assumed whilst low-yield donor charges are multiples of 0.75 kg (up to four required for the largest UXO). For donor charges for high-order clearance activities, charge weights of 1.2 kg (the most common) and 3.5 kg (single barracuda blast charge) have been included.

1.4.3.9 The clearance activities will be tide and weather dependent. The aim is to enable clearance of at least one UXO per tide, during the hours of daylight and good visibility. There is an assumption of up to 0.5 kg Net Explosive Quantity (NEQ) clearance shot for neutralisation of residual explosive material at each location.

Table 1.7: MDS for UXO clearance.

Parameter	UXO Maximum Design Scenario
Number of UXOs to be cleared within the Mona Array Area and Mona Offshore Cable Corridor and Access Areas	22
High order UXO	
High order UXO	From 25 kg to 907 kg (absolute maximum), with 130 kg the most likely (common) maximum
High order donor charges	
High order detonation donor charges	1.2 kg (most common) and 3.5 kg (single barracuda blast charge)

Parameter	UXO Maximum Design Scenario
NEQ clearance shot	0.5 kg
Low order	
Low order clearance charge	0.08 kg
Low yield clearance configurations	Up to four charges of 0.75 kg

Summary of the assessment presented in the Environmental Statement

1.4.3.10 For full details of the UXO clearance injury ranges see Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4).

1.4.3.11 Primary mitigation, in the form of using low order techniques to clear UXOs where possible, can be employed to reduce the likelihood of injury, noting however, that low order techniques are not always possible and are dependent upon the individual situations surrounding each UXO. Injury ranges as a result of UXO clearance using low order techniques are presented in Table 1.8. Given the uncertainty associated with low order techniques, high order detonation ranges are presented in Table 1.9 (high order donor charges) and Table 1.10 (high order UXO detonation).

1.4.3.12 An absolute maximum UXO size of 907 kg (high order explosion) yielded the largest PTS ranges for all species, with the greatest injury range (15,370 m) seen for harbour porpoise (using the SPLpk metric) (Table 1.10). The most likely (common) maximum 130 kg charge suggests an injury range of 8,045 m for harbour porpoise (SPL_{pk}).

Table 1.8: Potential PTS ranges for low order and low yield UXO clearance activities.

Charge Size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
0.08 kg low-order donor charge	SPL_{pk}	685	40	122	135
	SEL	190	2	47	9
0.5 kg clearing shot	SPL_{pk}	1,265	73	223	247
	SEL	421	4	115	22
2 x 0.75 kg low-yield charge	SPL_{pk}	1,820	105	322	357
	SEL	650	7	196	38
4 x 0.75 kg low-yield charge	SPL_{pk}	2,290	133	406	449
	SEL	840	10	275	53

Table 1.9: Potential PTS ranges for donor charges used in High Order UXO clearance activities.

Charge Size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
1.2kg	SPL_{pk}	1,690	98	299	331

Charge Size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
	SEL	596	6	176	34
3.5kg	SPL_{pk}	2,415	140	427	473
	SEL	885	10	297	57

Table 1.10: Potential PTS ranges for high order UXO detonation.

Charge Size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
25 kg UXO	SPL_{pk}	4,645	268	825	910
	SEL	1,645	27	775	147
130 kg UXO	SPL_{pk}	8,045	464	1,425	1,580
	SEL	2,520	61	1,705	323
907 kg UXO	SPL_{pk}	15,370	890	2,720	3,015
	SEL	3,820	151	4,215	800

1.4.4 Geophysical surveys

1.4.4.1 Geophysical surveys during the construction phase of the Mona Offshore Wind Project have the potential to result in elevated levels of underwater sound that are detectable by marine mammals above background levels and could result in auditory injury.

Maximum design scenario

1.4.4.2 Geophysical site investigation activities will include a range of different sonar-like sources, including Multi-Beam Echo-Sounder (MBES), Sidescan Sonar (SSS), Single Beam Echosounder (SBES), Sub-Bottom Profiler (SBP), and sparker sources used for Ultra High Resolution Seismic (UHRS) surveys. The equipment likely to be used can typically work at a range of signal frequencies, depending on the distance to the bottom and the required resolution. For sonar-like sources the signal is highly directional, acts like a beam and is emitted in pulses. Sonar-based sources are considered by the National Marine Fisheries Service (2016) as continuous (non-impulsive) because they generally comprise a single (or multiple discrete) frequency as opposed to a broadband signal with high kurtosis, high peak pressures and rapid rise. Unlike the sonar-like survey sources, the UHRS is likely to utilise a sparker, which produces an impulsive, broadband source signal. A full description of the source sound levels for geophysical survey activities is provided in Volume 5, Annex 3.1: Underwater sound technical report of the Environmental Statement (Document Reference F5.3.1).

1.4.4.3 Pre-construction geophysical survey will take place over a period of up to eight months. The MDS parameters for geophysical surveys are presented in Table 1.11.

Table 1.11: MDS for geophysical surveys.

Source	Source level (dB re 1µPa re 1m)	Frequency (kHz)
MBES	180 – 240 (rms)	200 - 500
SSS	216 – 228 (rms)	200 - 700
SBES	180 – 240 (rms)	200 - 400
SBP	200 – 240 (rms) chirp 200 – 235 (rms) pinger	0.2 - 14 (chirp) 2 - 7 (pinger)
UHRS	170 – 200 (rms)	0.05 - 4

Summary of the assessment presented in the Environmental Statement

1.4.4.4 For full details of the geophysical site investigation surveys injury ranges see Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4). With respect to the ranges within which there is a potential of injury (PTS) occurring to marine mammals as a result of geophysical investigation activities, the PTS is expected to occur out to a maximum of 254 m for harbour porpoise due to SBP (Table 1.12). For HF cetaceans (e.g. dolphin species) the PTS is expected to occur out to a maximum of 41 m for MBES. LF cetaceans and PCW (e.g. minke whale and pinniped species respectively), may be affected by PTS out to 40 m due to SBP.

Table 1.12: Potential impact ranges (m) for marine mammals for geophysical site investigation surveys (N/E = threshold not exceeded).

[1]Non-impulsive threshold used from Southall *et al.* (2019)

[2]Impulsive threshold used from Southall *et al.* (2019)

Species (hearing group)	Source / Potential impact range (m) for PTS				
	MBES[1]	SSS[1]	SBES[1]	SBP[1]	UHRS[2]
Harbour porpoise (VHF)	68	41	68	254	11
Bottlenose dolphin, Short-beaked common dolphin, Risso's dolphin (HF)	41	2	12	40	N/E
Minke whale (LF)	12	2	12	40	N/E
Grey seal and harbour seal	25	6	25	40	N/E

1.5 Mitigation methodology

1.5.1.1 To minimise the potential for injurious effects to marine mammals due to underwater sound caused by UXO clearance, pile driving and geophysical surveys, there is a set of precautionary steps that will be implemented in line with current guidelines (JNCC,

2017, JNCC, 2010a, JNCC, 2010b). These measures may encompass, but are not restricted to, the following:

- Establishment of a designated mitigation zone
- Monitoring of mitigation zone through visual observation using qualified and trained Marine Mammal Observers (MMOs)
- Utilization of a Passive Acoustic Monitoring (PAM) System
- Deployment of Acoustic Deterrent Devices (ADDs)
- Establishment of communication channels between MMOs, PAM and ADD operators
- Implementation of a gradual soft start and ramp up procedures.

1.5.1.2 The specific measures to mitigate the injurious effects of UXO clearance, piling and geophysical surveys during the pre-construction and construction phases of the Mona Offshore Wind Project will be determined post-consent in consultation with the licensing authority (NRW) and SNCBs. The determination of final parameters will occur following the collation of additional data and selection of installation contractors, which will provide confirmation of the final parameters (such as foundation types, hammer energies, expected UXO sizes). Furthermore, the evolving technologies will be assessed as they mature. All this supplementary data and information will be used to inform the final MMMP and discussions regarding the final mitigation measures.

1.5.1.3 The subsequent sections outline a high-level approach for each of the general components listed in paragraph 1.5.1.1 and provide more detail for impact-specific measures adopted as a part of the project (see sections 1.7, 1.8 and 1.9).

1.6 General mitigation procedures

1.6.1 Mitigation zone

1.6.1.1 The mitigation zone is defined as the area over which pre-start monitoring will be undertaken to record the presence of marine mammals. If marine mammals are recorded within the mitigation zone during the pre-start search, the operations will be delayed until such a time as there have been no sightings of marine mammals and/or acoustic recordings of marine mammals within the mitigation zone for a minimum of 20 minutes (regardless of the type of activity).

1.6.1.2 Following JNCC guidelines, the standard mitigation zone for pre start monitoring has been determined as having a minimum radius of 500 m from the source of piling sound (JNCC, 2010a) and geophysical surveys (JNCC, 2010a), and 1 km for UXO clearance (JNCC, 2010b).

1.6.2 Marine Mammal Observers

1.6.2.1 Dedicated[1] and trained MMOs will be used to survey the mitigation zone at any one time and conduct the pre-start searches (and post detonation searches in the case of UXO clearance). The MMOs will be JNCC certified and have an appropriate level of field experience (i.e. a minimum of one year's MMOs experience on offshore projects).

[1] A dedicated MMO is defined as an observer with the sole role on board of conducting visual watches for marine mammals.

1.6.2.2 A minimum number of MMOs will be agreed with NRW (as the licensing authority) post-consent. MMOs should be present in sufficient numbers to ensure that monitoring is not compromised by fatigue.

1.6.2.3 The MMO will carry out pre-start monitoring from an appropriate elevated platform that allows 360° visualisation (full coverage of the mitigation zone) and record all relevant information, including the start and end times of monitoring. Environmental conditions such as sea state, weather, and visibility, as well as any marine mammal sightings, will also be documented according to JNCC marine mammal recording forms and guidelines. If relevant, any noticeable behavioural changes in animals in response to ADD activation, such as change in direction of travel, will be recorded.

1.6.2.4 The MMOs will be equipped with reticule binoculars and marine mammal reporting forms and will be capable of determining the extent of the search zone in relation to their viewing platform. A range stick may be used to aid the estimation of distance of the sighting from the survey vessel. The lead MMOs should also be equipped with a two-way radio to ensure communication with both the vessel crew and the PAM Operator. This is to allow any visual or acoustic detections of marine mammals in the mitigation zone and any subsequent delay required to the commencement of surveying to be communicated quickly and effectively between all parties. MMOs will communicate any detections of marine mammals with the PAM operator.

1.6.2.5 The precise information pertaining to MMOs and the methods they employ will be revised and specified in the final MMMP, taking into consideration any updated guidance and available resources at the time.

1.6.2.6 The MMOs must be familiar with the regulatory procedures pertaining to managing risk to marine mammals from underwater sound and to ensure compliance must be provided with full details of all licence/consent conditions relevant to the performance of their role in advance of activity commencing. The MMOs, together with the PAM Operator, will provide a detailed introduction during the pre-works introduction session/s to advise the offshore team on the implementation of the procedures set out in this Outline MMMP.

1.6.2.7 The MMOs should ensure their efforts are concentrated on the mitigation periods (i.e. the pre-start search and soft start time periods). The JNCC guidelines, and this Outline MMMP, should not be interpreted to imply that MMOs should continue a visual search during all available hours, unless it is directly specified as a survey consent or licence condition.

1.6.2.8 The MMOs will have the necessary authority to implement the plan and advise a ‘stop works’ if necessary (unless piling is at full power, in which case there is no requirement to stop (JNCC, 2010a)).

1.6.3 Passive Acoustic Monitoring (PAM) Operators

1.6.3.1 The PAM Operator will acoustically track vocalising marine mammals using a hydrophone, deployed to a suitable depth from the operation vessel. The hydrophone data will be monitored by the PAM Operator via a computer interface using the software PAMGuard. This allows the PAM Operator to detect vocalisations, and signal strengths give an indication of the position of the animal relative to the hydrophone (i.e. the signal becomes weaker as the animal moves further away). The PAM Operator will communicate with the MMOs to ‘ground truth’ any detection of marine mammals to validate species identification and determine approximate position.

1.6.3.2 Dedicated PAM Operators will be responsible for deployment, maintenance and operation of the PAM hydrophone, including spares. The PAM Operator will be based on the vessel together with the MMOs and will be responsible for recording all acoustic marine mammal detections in the appropriate format. Together with the MMOs, PAM Operators will be responsible for compiling all the data on marine mammal observations, mitigation activities (including ADDs and soft start) and instances of noncompliance, for reporting to NRW and the Marine Noise Registry (see section 1.10).

1.6.3.3 A minimum number of PAM Operators will be agreed with JNCC and SNCBs post-consent. PAM Operators should be present in sufficient numbers to ensure that monitoring is not compromised by fatigue. The PAM Operator should ensure their efforts are concentrated on the mitigation periods, (i.e. the pre start search and soft start time periods). The JNCC guidelines, and this Outline MMMP, should not be interpreted to imply that PAM Operators should continue an acoustic search during all available hours, unless specified as a survey consent or licence condition.

1.6.3.4 The extent to which the PAM will be able to acoustically record marine mammals will depend on the equipment used, weather and the species present. For example, the detection ranges of C-POD systems (which are used for stationary activities such as UXO or piling) are contingent on ambient or background sound conditions, but they are generally estimated to be around 200 to 300 m for detecting echolocation clicks produced by harbour porpoises in typical scenarios (Benjamins *et al.*, 2017).

1.6.3.5 To ensure compliance they must be provided with full details of all licence/consent conditions relevant to the performance of their role in advance of activity commencing. The PAM Operator, together with the MMOs, will provide a detailed introduction during the pre-works introduction session/s to advise the offshore team on the implementation of the procedures set out in this Outline MMMP.

1.6.3.6 The PAM Operator will be suitably trained in passive acoustic monitoring and the use of PAMGuard software, with training having been provided by an appropriate organisation. The PAM Operators will also have an appropriate level of field experience (i.e. a minimum of one year PAM experience on offshore projects) and must be familiar with the UK regulatory procedures pertaining to managing risk to marine mammals and marine turtles from underwater sound.

1.6.3.7 PAM Operators will be responsible for confirming the correct functioning of the ADD (via PAMGuard software) and communicating to the ADD Operator if the ADD is not operating properly and will have the necessary authority to implement this Outline MMMP and advise a stop works if necessary.

1.6.4 Acoustic Deterrent Devices (ADDs)

1.6.4.1 Devices with the capability to deter animals from entering the mitigation zone, such as ADDs, will be employed in combination with visual and/or acoustic monitoring. ADDs offer the potential to decrease the risk of harming marine mammals and are a cost-effective solution. An assessment of the prospective effectiveness of these devices on the primary marine mammal species expected in the area will be conducted at the post-consent stage.

1.6.4.2 A trained and dedicated ADD Operator will be responsible for ADD maintenance, operation and reporting (see section 1.10). The ADD Operator will be responsible for deploying the ADD, verifying the operation of the ADD before deployment, operating the ADD, ensuring that batteries are fully charged, and that spare equipment is available.

1.6.4.3 The ADD Operator will also communicate to the MMOs/PAM Operator on all ADD activity so the details of any ADD used and any relevant observations on their efficacy can be reported (see section 1.10).

1.6.5 Communications

1.6.5.1 It should be also noted, that outside of the dedicated roles that MMO and PAM Operators have in line with recent guidance (JNCC, 2017, JNCC, 2010a, JNCC, 2010b), responsibilities of onshore as well as offshore works team needs to be fulfilled for the mitigation measures to be effective. Indicative roles are described below in this Outline MMMP, and whilst roles and titles may change as the project progresses, it will be detailed in the final MMMP document.

1.6.5.2 A dedicated onshore team will be responsible for ensuring that all compliance documents, including the final MMMP, are included in construction contract documents, including those pertaining to piling, UXO clearance and geophysical/seismic surveys.

1.6.5.3 The person accountable for the offshore project management (e.g. Project Manager Construction Phase or equivalent), will be responsible for providing a pre works introduction sessions, and for ensuring that all construction phase activities are conducted in accordance with the final MMMP, with other related consent management plans, and with all relevant regulations and legislation. This person will report marine mammal monitoring and activities (related to geophysical/seismic surveying, UXO clearance and piling) and will be responsible for reporting any events of non-compliance with the MMMP and/or consent conditions to NRW. It should be noted that depending on the activities planned, this person will hold a different title (e.g. during geophysical surveys the Project Manager is often referred to as a Party Chief).

1.6.5.4 During the operations, there will be also a dedicated Project Manager for Offshore Installations (or equivalent) who holds overall responsibility for the actual operations during piling and geophysical/seismic surveying, based on the piling or survey vessel, and is likely to be a different individual for each activity. This person will be in control of initiating, delaying or pausing operations (if flagged by MMOs/PAM) and is the main point of communication between the MMOs, PAM Operator and ADD Operator and the operations teams (which comprise those personnel responsible for carrying out piling and geophysical/seismic survey activities). Similarly, depending on the activities planned, this person will hold a different title (e.g. during geophysical surveys they are often referred to as a Chief Observer). Similar roles during UXO clearance operations may be fulfilled by the Explosive Ordnance Disposal (EOD) Supervisor who has overall responsibility for the detonations programme and is based on the main UXO clearance operations vessel. The EOD Supervisor would also be the main point of communication between the MMOs, PAM Operator and ADD Operator and the EOD support teams (i.e. those personnel responsible for carrying out UXO clearance activities). The EOD Technical Advisor will be in control of initiating, delaying or pausing the detonation activities. Additional support to the mitigation team will be provided by members of the EOD Supervisor's team.

1.6.5.5 At the planning stage, the communication channels between MMOs, PAM Operator and ADD Operator, and the offshore team are to be established. A range of responsibilities should be assigned to the relevant offshore team members along with appropriate titles and shared with the MMO, PAM and ADD Operators. The MMOs and PAM Operator must ensure there is a workable communication procedure in place so that any visual and acoustic detections can be compared. In addition, a formal chain

of communication from the MMOs or PAM Operator to the person who can start/stop operations must be established. This is important, because contractors working to a tight timetable may not fully appreciate the roles and responsibilities of the MMOs and PAM Operators. In order to establish the chain of communication and command MMOs and PAM Operators should attend pre-mobilisation kick off meetings as well as daily update meetings once mobilised.

1.6.6 Soft start procedures

1.6.6.1 In a soft start procedure, the power and strike rate for pile driving, acoustic energy output for geophysical surveys (where possible, see paragraph 1.9.5.1), or the charge size for UXO clearance is increased incrementally over a defined time period before reaching full operational power or before the main detonation event. The soft start duration depends on the activity and is described in more detail for piling, UXO clearance and geophysical surveys sections 1.7, 1.8 and 1.9, respectively.

1.7 Piling

1.7.1 Overview

1.7.1.1 Figure 1.2 provides a visual representation of the sequence of events and the necessary lines of communication for implementing this Outline MMMP. All steps presented in Figure 1.2 are described in more detail in this section.

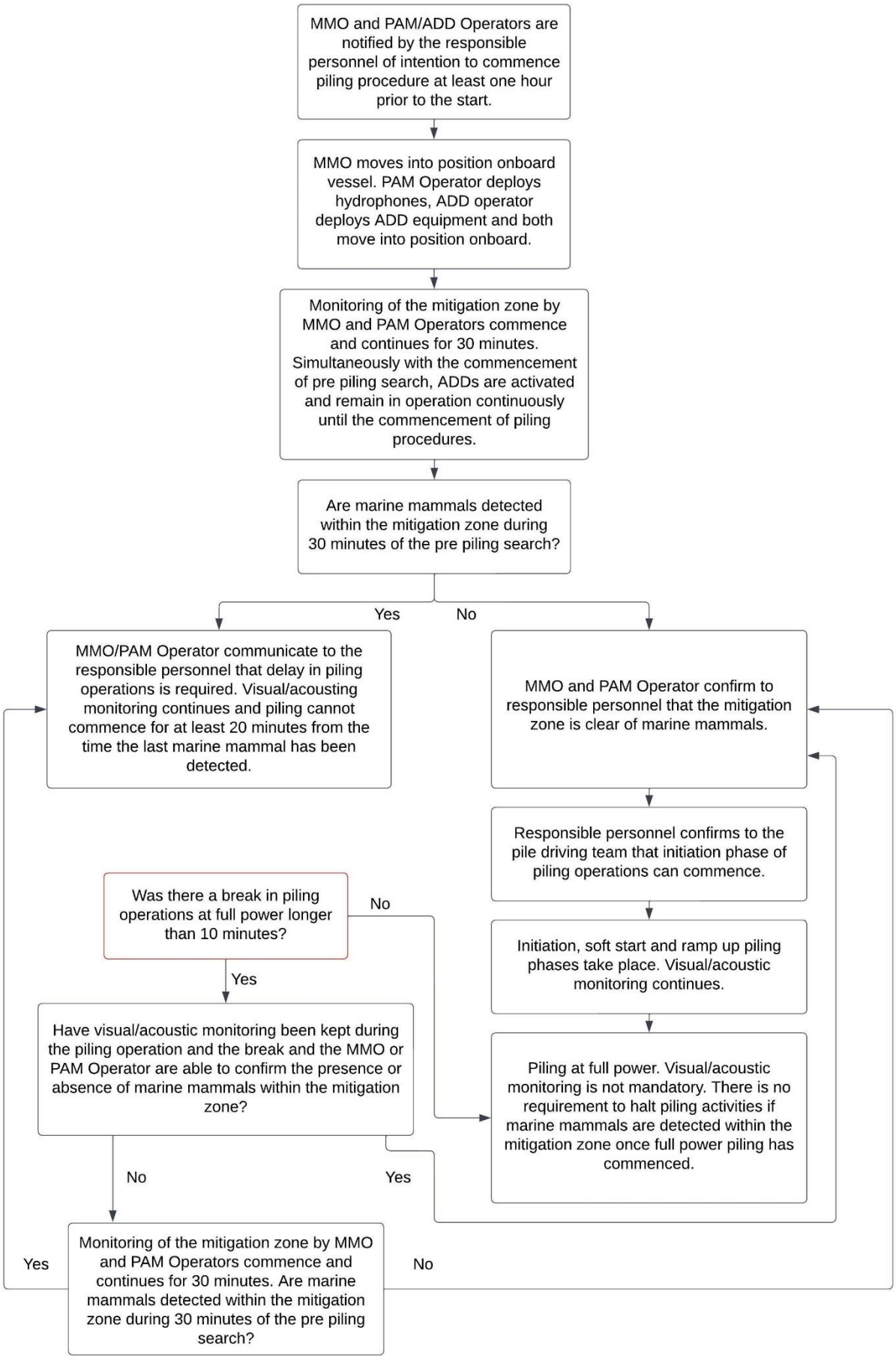

Figure 1.2: Piling mitigation.

1.7.2 Mitigation zone

1.7.2.1 Following the JNCC (2010a) guidelines, a pre-piling monitoring of at least 500 m zone should be conducted by MMO in order to reduce the risk of marine mammals being present within this area. MMOs should be present in sufficient numbers to ensure that monitoring is not compromised by fatigue. Prior to the commencement of the pre-piling monitoring, an individual who hold overall responsibility for operations during piling (e.g. Head of Operations, see paragraph 1.6.5.1) will provide advance notice to the MMOs, PAM and ADD Operators at least one hour prior to the scheduled commencement of piling operations. This advance notice will allow for an adequate time period for the survey and the soft start procedure.

1.7.2.2 For the Mona Offshore Wind Project, the mitigation zone will be determined considering the largest injury zone across all species. As described in paragraph 1.4.2.7, the maximum range of injury based on SPL_{pk} metric across all species was predicted for harbour porpoise at 662 m at full hammer of 4,400 kJ. For SEL_{cum} metric, the risk of PTS may occur out to a maximum range of 7,520 m, predicted for minke whale during consecutive piling.

1.7.2.3 The PTS onset ranges will be further reduced by application of ADDs, described in more detail in paragraph 1.7.5.1. Following the ADD activation for 30 minutes, there remains a residual risk of injury to minke whale within a range of a maximum 3,370 m during consecutive piling. As this range may not be able to be covered with MMO/PAM alone (noting that MMO and PAM techniques are developing and changing), alternative monitoring strategies will be discussed in the final MMMP post consent if required to extend the range over which efficient mitigation can be conducted.

1.7.2.4 Furthermore, the Applicant will revisit the sound modelling post-consent as a part of the final UWSMS once all the project details are finalised. Subsequently, a specific mitigation zone for piling at the Mona Offshore Wind Project will be established in the final MMMP based on the confirmed parameters (e.g. hammer energy).

1.7.3 Visual monitoring

1.7.3.1 In accordance with JNCC (2010a) recommendations, a pre-piling monitoring of a minimum duration of 30 minutes will take place prior to the commencement of the piling operations as well as during initiation, soft start and ramp up procedures. During this period, MMOs will conduct visual monitoring for marine mammals within the designated mitigation zone around the piling location.

1.7.3.2 If a marine mammal is identified within the mitigation zone during the MMO's pre-piling monitoring, the initiation/soft start procedure will be postponed until the MMO confirms that the marine mammal has left the mitigation zone and at least 20 minutes have passed since the last detection within the mitigation zone. Throughout the initiation to ramp up phases, the MMO will continue to document any detections and observations of animal presence and behaviour. In the event that a marine mammal enters the mitigation zone while a soft start is in progress, whenever possible the piling operation should cease or at a minimum, offshore team should be advised by the MMO to refrain from increasing the power further until the marine mammal leaves the mitigation zone and there have been no further detections for a period of 20 minutes.

1.7.3.3 The precise information pertaining to MMOs and the methods they employ will be revised and specified in the final MMMP, taking into consideration any updated guidance and available resources at the time.

1.7.4 Passive acoustic monitoring

1.7.4.1 The PAM will be conducted by a PAM Operator in conjunction with visual monitoring during daylight operations as an additional measure to ensure effective detection of marine mammals within the mitigation zone.

1.7.4.2 During periods of limited visibility, such as night time, fog or high sea states above sea state 4, it will be necessary to conduct the monitoring of the mitigation zone using PAM due to a higher risk of failing to visually detect the presence of marine mammals under such conditions.

1.7.5 Pre-piling deployment of ADDs

1.7.5.1 Due to the potential injury ranges predicted for marine mammals during piling (see section 1.4.2), ADD will be applied to deter animals from the area of impact. The JNCC (2010a) draft guidance for piling mitigation recommends their use, particularly in respect of periods of low visibility or at night to allow 24-hour working. The ADD will be verified for operation prior to pre-piling activation by the ADD Operator. ADDs will be used alongside visual and/or acoustic monitoring and not as a replacement for these methods.

1.7.5.2 Sound modelling was carried out to determine the potential efficacy of using this device to deter marine mammals from the injury zone for a selected duration of 30 minutes (see Volume 5, Annex 3.1: Underwater sound technical report of the Environmental Statement (Document Reference F5.3.1)). Assuming conservative swim speeds, it was demonstrated that activation of an ADD for 30 minutes would deter all animals beyond the maximum injury zone predicted using SPL_{pk} at full hammer energy (Table 1.13).

Table 1.13: Summary of peak pressure (SPLpk) injury ranges at full hammer energy for marine mammals due to single piling of pin piles at 4,400 kJ and 3,000 kJ hammer energy, showing whether the individual can move away from the injury range during the 30 minutes of ADD activation.

Species	Threshold	Injury range at 4,400 kJ (m)	Injury range at 3,000 kJ (m)	Swim Speed (m/s)	Swim distance (m)	Move away
Minke whale	219 dB re 1 µPa (pk)	123	98	2.3	4,140	Yes
Bottlenose dolphin, Risso's dolphin, white-beaked dolphin	230 dB re 1 µPa (pk)	41	33	1.52	2,736	Yes
Harbour porpoise	202 dB re 1 µPa (pk)	662	525	1.5	2,700	Yes
Grey seal, harbour seal	218 dB re 1 µPa (pk)	136	108	1.8	3,240	Yes

1.7.5.3 Activation of an ADD 30 minutes prior to commencement of piling of pin piles reduced the likelihood of PTS to a level not exceeding the SEL_{cum} injury thresholds during single, concurrent and consecutive piling for all species except minke whale (Table 1.13). Following the ADD activation for 30 minutes, there is a residual risk of injury to minke whale within a range of a maximum 3,370 m during consecutive piling (Table

1.14). As discussed in paragraph 1.7.2.3, the mitigation zone will be based on minke whale.

Table 1.14: Injury ranges (SEL_{cum}) for marine mammals due to single, concurrent (3,000 kJ and 3,000 kJ) and consecutive piling (24 hours) of pin piles with and without 30 minutes of ADD (N/E = threshold not exceeded).

Species	PTS Threshold (SEL weighted)	Scenario	Hammer energy	Without ADD	With ADD
Minke whale (LF)	183 dB re 1 µPa²s	Single	4,400 kJ	7,420	3,290
			3,000 kJ	4,230	264
		Concurrent	3,000 kJ + 3,000 kJ	5,710	1,575
		Consecutive	4,400 kJ	7,520	3,370
			3,000 kJ	4,290	327
All other marine mammal species	HF – 185 dB re 1 µPa²s VHF – 155 dB re 1 µPa²s PCW – 185 dB re 1 µPa²s	Single	4,400 kJ	N/E	N/E
			3,000 kJ	N/E	N/E
		Concurrent	3,000 kJ + 3,000 kJ	N/E	N/E
		Consecutive	4,400 kJ	N/E	N/E
			3,000 kJ	N/E	N/E

1.7.5.4 There are various ADDs available with different sound source characteristics (McGarry *et al.*, 2017) and a suitable device will be selected based on the key species requiring mitigation for the Mona Offshore Wind Project. The type of ADD will be discussed and agreed with relevant stakeholders post-consent and included in the final MMMP.

1.7.5.5 As per the JNCC (2010a) guidelines, it is recommended that ADDs should be activated throughout the entire pre-piling monitoring and deactivated immediately after piling (initiation) activity commences. Considering that the recommended minimum duration for the pre-piling monitoring is 30 minutes, the ADD should be in operation continuously for during this period. The deactivation will only occur once it has been confirmed by the MMOs and the PAM Operator that the mitigation zone has remained free of marine mammals for at least 20 minutes. The timing of the ADDs activation period will be a subject of discussion and agreement with NRW and JNCC post-consent to ensure that this mitigation measure effectively clears the mitigation zone without causing avoidable disturbances to the environment.

1.7.5.6 Activation of ADD for a duration of 30 minutes prior to the commencement of piling (initiation, soft start and ramp up phases), will reduce the risk of injury based on the SPL_{pk} to negligible for all marine mammal species. The underwater sound modelling estimated that the activation of ADD for a duration of 30 minutes will reduce the risk of injury based on SEL_{cum} to negligible for all marine mammal species, except minke whale. For minke whale the SELcum injury range has been reduced from 7,520 m without ADD to 3,370 m with the application of ADD for a duration of 30 minutes. As such, within the range of 3,370 m the risk of injury to minke whale remains and defines the Mitigation Zone, although due to low densities of this species within the Mona marine mammal study area the risk of encountering an individual within this range is

very small. As previously described in paragraph 1.7.2.3, the sound modelling and mitigation measures will be evaluated post-consent (with more detailed information on project design and programme available) and the final MMMP will include measures to further reduce the risk of injury during piling.

1.7.6 Soft start and ramp up procedure

1.7.6.1 After the 30 minute pre-piling monitoring and confirmation that no marine mammals have been sighted or detected in the mitigation zone for at least 20 minutes (as detailed in paragraph 1.7.3.2 for pre-piling monitoring), the piling initiation, soft start and ramp up will commence. This will involve the implementation of a low hammer energy with a low number of strikes used initially, followed by lower hammer energies at a higher strike rate at the beginning of the piling sequence before energy input is 'ramped up' (increased) over time to required higher levels.

1.7.6.2 For both scenarios (full power piling at 3,000 kJ and 4,400 kJ), the piling sequence will start with a 10 minute initiation phase with hammer energy of 320 kJ at a strike rate of 1 strike per minute for 10 minutes. Following the initiation phase, a soft start will commence with hammer energy of 320 kJ and a strike rate of 10 strikes per minute over a duration of 20 minutes.

1.7.6.3 For the 4,400 kJ scenario at 16 wind turbine locations (jackets) and all OSPs, the hammer energy will be gradually increased during the ramp up phase, from 320 kJ to a maximum of 3,900 kJ with strike rate of 15 strikes per minute. The duration of the ramp up phase is 20 minutes. Full power piling will then take place over 331 minutes at a maximum hammer energy of 4,400 kJ with a maximum strike rate of 80 strikes per minute.

1.7.6.4 For the 3,000 kJ at 48 wind turbine locations (jackets) and all gravity base foundations, the hammer energy will be gradually increased during the ramp up phase from 320 kJ to a maximum of 2,500 kJ with strike rate of 15 strikes per minute. The duration of the ramp up phase is 20 minutes. Piling will take place over 331 minutes at a maximum hammer energy of 3,000 kJ with a maximum strike rate of 80 strikes per minute.

1.7.7 During piling at full power

1.7.7.1 It is recognised that, for engineering reasons, it may be infeasible to stop piling at full power until the pile reaches its final position. Consequently, in line with JNCC (2010a) guidelines, if marine mammals are detected within the mitigation zone during the full power piling, there will be no obligation to cease or reduce piling energy, as the animal would be regarded as having entered the area voluntarily.

1.7.7.2 If, for any reason, there is an interruption in piling activity lasting more than 10 minutes, the pre-piling monitoring period will be re-initiated and a full soft start and ramp-up procedure will be performed before resuming piling (JNCC, 2010a). If a watch has been kept during the full power piling phase and the break period and the MMOs and PAM Operator are able to confirm the presence or absence of marine mammals within the mitigation zone in the last 30 minutes, then there is a possibility of initiating the soft start immediately following the break. However, in cases where no monitoring of the mitigation zone has occurred, the complete pre-piling monitoring and soft start procedure should be conducted (Figure 1.2).

1.8 UXO clearance

1.8.1 Overview

1.8.1.1 Figure 1.3 provides an example of a sequence of events and the necessary lines of communication for implementing this Outline MMMP for UXO clearance. All steps presented in Figure 1.3 are described in more detail in this section.

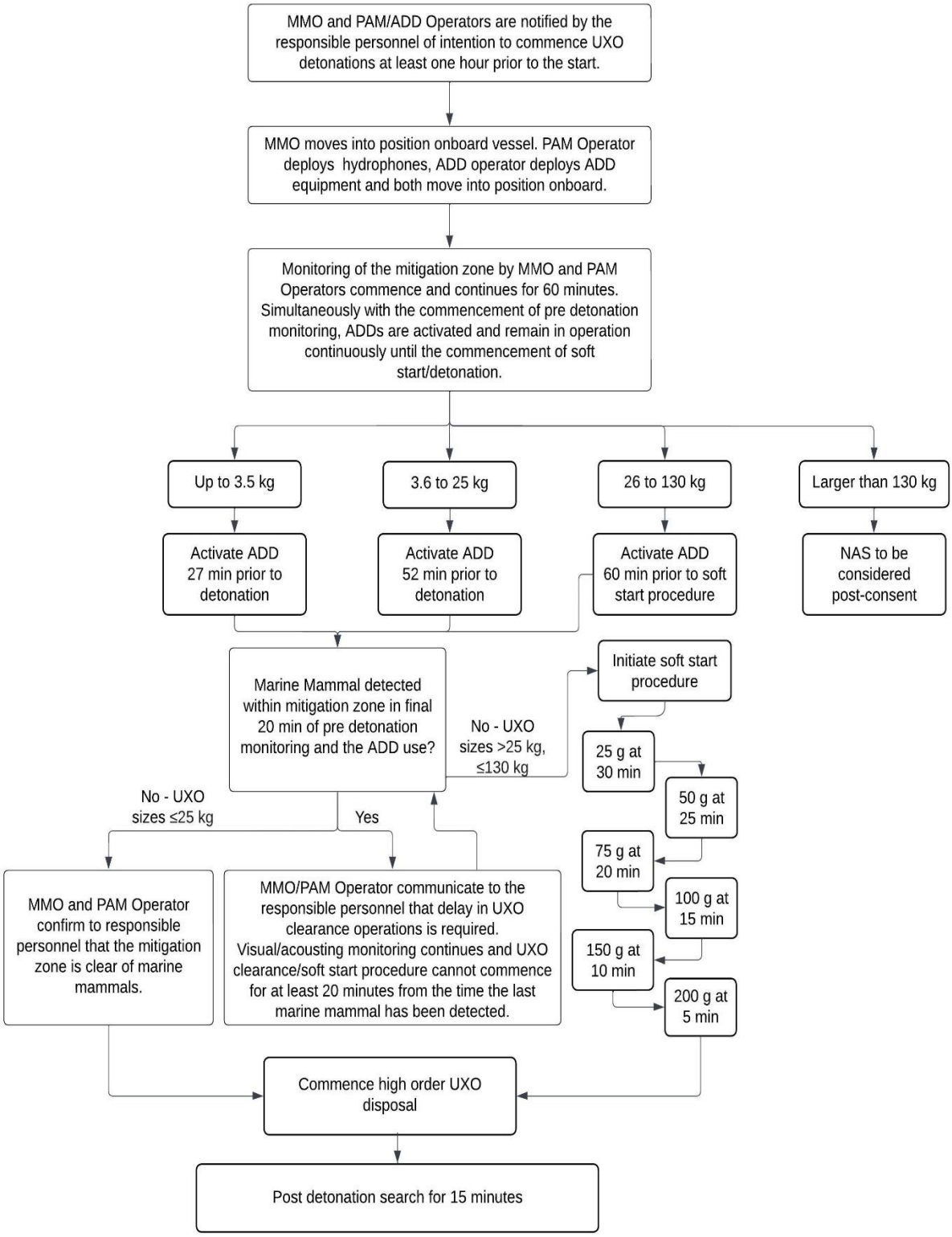

Figure 1.3: UXO clearance mitigation.

1.8.2 Mitigation zone

1.8.2.1 Following the JNCC (2010b) guidelines, a pre-detonation monitoring of at least 1 km zone should be conducted by MMO in order to reduce the risk of marine mammals being present within this area. MMOs should be present in sufficient numbers to ensure that monitoring is not compromised by fatigue. Prior to the commencement of the pre-detonation monitoring, an individual who hold overall responsibility for operations during UXO clearance (e.g. EOD Supervisor, see paragraph 1.6.5.1) will provide advance notice to the MMOs, PAM and ADD Operators at least one hour prior to the scheduled commencement of UXO clearance. This advance notice will allow for an adequate time period for the survey and the soft start procedure.

1.8.2.2 Whilst the Mona Offshore Wind Project has committed to a hierarchical approach to UXO (paragraph 1.4.3.1) with a preference for low order where possible, for the Mona Offshore Wind Project, the mitigation zone will be determined considering the largest injury zone across all species. Therefore, as described in paragraph 1.4.3.11, the maximum range of injury based on SPL_{pk} metric across all species was predicted for harbour porpoise at 15,370 m, as a result of high order explosion of the absolute maximum UXO size (907 kg). However, the most likely (common) maximum 130 kg suggested an injury range of 8,045 m for harbour porpoise ($SPL_{pk,}$ see Table 1.10). Low order UXO clearance results in further reduced injury ranges (Table 1.8).

1.8.2.3 Due to large injury ranges associated with high order detonation for UXO sizes larger than 130 kg, the Applicant commits to consider additional NAS as secondary mitigation post-consent if the low order clearance techniques are assessed as not feasible to use. This will be evaluated as a part of the final UWSMS and if relevant, consideration of NAS secondary mitigation will be included in the final MMMP. However, in this Outline MMMP, a range of UXO sizes have been considered for the purpose of determining effective and tailored secondary mitigation measures, up to a maximum realistic of a UXO size of 130 kg.

1.8.2.4 Given that during the high order detonation of all considered UXO sizes (Table 1.7) injury to harbour porpoise could occur beyond the 1 km standard mitigation zone, an ADD will also be deployed and activated to deter animals from the potential injury zone, described in more detail in paragraph 1.8.5.1. Furthermore, the Applicant will revise the noise modelling post-consent, once all the project details are finalised and the specific mitigation zone for UXO clearance at Mona Offshore Wind Project will be established in the final MMMP based on the confirmed parameters (e.g. UXO sizes that can be anticipated confirmed by geophysical surveys).

1.8.3 Visual monitoring

1.8.3.1 In accordance with JNCC (2010b) guidelines, a pre-detonation monitoring of a minimum duration of 60 minutes will take place prior to the commencement of the UXO clearance operations as well as during initiation, soft start and ramp up procedures. During this period, MMOs will conduct visual monitoring for marine mammals within the designated mitigation zone around the UXO clearance location. Depending upon the size of the mitigation zone, more than one MMO viewing platform (and therefore more than one vessel) may be required to ensure that the entire mitigation zone can be observed. UXO clearance operations will only take place during the hours of daylight and good visibility as the MMOs should be able to monitor the full extent of the mitigation zone.

1.8.3.2 If a marine mammal is identified within the mitigation zone during the MMO's pre-detonation monitoring, the soft start UXO clearance procedure will be postponed until

the MMO confirms that the marine mammal has left the mitigation zone and at least 20 minutes have passed since the last detection within the mitigation zone. It should be also noted that in line with guidelines, the MMO(s) should concentrate their efforts before, during and after detonation and to document any detections and observations of animal presence and behaviour. In the event that MMO or PAM Operator is uncertain whether marine mammals are present within the mitigation zone, they should advise that the activity should be delayed as a precaution until they are certain that no animals are present.

1.8.3.3 The precise information pertaining to MMOs and the methods they employ will be revised and specified in the final MMMP, taking into consideration any updated guidance and available resources at the time.

1.8.4 Passive acoustic monitoring

1.8.4.1 PAM will be conducted by a PAM Operator in conjunction with visual monitoring during daylight operations as an additional measure to ensure effective detection of marine mammals within the mitigation zone.

1.8.4.2 During periods of limited visibility, such as night time, fog or high sea states above sea state 4, it will be necessary to conduct the monitoring of the mitigation zone using PAM due to a higher risk of failing to visually detect the presence of marine mammals under such conditions. While ideally sea-states of 2 or less are required for optimal visual detection, the risks of not detecting individuals are reduced by combining visual monitoring with PAM (JNCC, 2010a).

1.8.5 Pre-detonation deployment of ADDs

1.8.5.1 Due to the potential injury ranges predicted for marine mammals during UXO clearance (see section 1.4.3), ADD will be applied to deter animals from the area of impact. The JNCC (2010b) guidance for UXO clearance mitigation recommends their use. The ADD will be verified for operation prior to pre-detonation activation by the ADD Operator. ADDs will be used alongside visual and/or acoustic monitoring and not as a replacement for these methods.

1.8.5.2 The ADD selected will be suitable for the target species and will be placed in the water in proximity to the UXO. ADD activation will commence at the start of pre-detonation search for a specified period (Table 1.15) which depends on the UXO size, to minimise the introduction of additional sound.

1.8.5.3 As such, in this Outline MMMP, a range of UXO sizes have been considered for the purpose of determining effective mitigation measures, with the application of ADD sufficient to reduce the risk of injury (PTS) to negligible up to a maximum realistic of a UXO size of 130 kg. The assumption is that marine mammals swim away from the ADD in a straight line at speeds summarised in Table . The duration of the activation of the ADD prior to UXO detonation will determine whether animals can move out of the potential injury zone. The potential range of displacement based on these swimming speeds for varying UXO sizes is summarised in Table .

1.8.5.4 The duration of ADD activation presented in Table 1.15 is tailored to the most sensitive species (e.g. harbour porpoise). For harbour porpoise a duration of 60 minutes of ADD would be sufficient to mitigate for UXO sizes up to 130 kg (Table 1.15, Figure 1.3). For all other species a duration of ADD for 15 minutes would be sufficient to deter marine mammals from the potential injury zones. Therefore, the application of 30 minutes of

ADD will reduce the risk of injury (PTS) as a result of high order detonation of 130 kg UXO to negligible for all species except harbour porpoise.

1.8.5.5 The use of soft start charges will, however, be applied in addition to the ADD (section 1.8.6) as these will further reduce the risk of injury to harbour porpoise.

Table 1.15: Recommended ADD Duration for High Order UXO Clearance and Associated Displacement Distance.

UXO size (kg)	ADD duration (min)	Displacement distance			
		Harbour porpoise (VHF)	Bottlenose dolphin, Short-beaked common dolphin, Risso's dolphin (HF)	Minke whale (LF)	Grey seal and harbour seal (PCW)
Up to 3.5	27	2,430	2,462	3,726	2,916
3.6 to 25	52	4,680	4,742	7,176	5,616
26 to 130	60 min	5,400	5,472	8,280	6,480
Maximum PTS range based on high order detonation of 130 kg (m)		**8,045**	**464**	**1,705**	**1,580**

1.8.5.6 Due to large injury ranges associated with high order detonation of UXO larger than 130 kg (e.g. the high order absolute maximum 907 kg UXO) (Table 1.15) which cannot be mitigated fully with ADD and soft start alone (illustrated in Figure 1.3), the Applicant has committed to considering additional secondary mitigation (such as NAS as an option) if required post consent, following further detail (see paragraph 1.4.3.5) from site investigation surveys. This will be evaluated and final mitigation secured in the final UWSMS (see section 1.1.3) to reduce the magnitude of impacts from elevated underwater sound from the Mona Offshore Wind Project, such that there is no significant effect (from injury or disturbance) on marine mammals or fish. An Outline UWSMS included as part of the application (Document Reference J21) sets out the process for the Final UWSMS, and Final UWSMS will be developed in consultation with the licensing authority and SNCBs.

1.8.6 Soft start procedure

1.8.6.1 To mitigate risk of injury to harbour porpoise for a UXO between 26 to 130 kg, the pre-detonation monitoring will be 60 minutes and include secondary mitigation in the form of soft start detonations, as per the JNCC (2010b) guidance. Following the 60 minute monitoring, the ADD will be switched off and the soft start will be undertaken using a sequence of small explosive charges detonated every 5 minutes over a total of 30 minutes (25 g at 30 mins prior to main detonation, 50 g at 25 mins, 75 g at 20 mins, 100 g at 15 min, 150 g at 10 min, 200 g at 5 min), allowing time for marine mammals to move away from the mitigation zone prior to the detonation of the UXO. Based on the findings presented in Volume 2, Chapter 4: Marine mammals of the Environmental Statement (Document Reference F2.4), it is expected that 90 minutes of deterrence activities, with a combination of ADD followed by the soft start procedures, will displace harbour porpoise to a range of up to 8,100 m. This is considered sufficient to deter most animals, however, there may be a residual effect for harbour porpoise for UXO larger than 130 kg (e.g. the predicted injury impact range for the 907 kg UXO size was

15,370 m). As described in paragraph 1.8.5.2, if relevant, for UXO sizes larger than 130 kg the use of NAS as secondary mitigation technique will be further discussed as an option and refined post-consent as a part of the final UWSMS and the final MMMP.

1.8.7 Post detonation search

1.8.7.1 Following detonation, the MMOs and PAM Operator will undertake a post detonation search of the mitigation zone for at least 15 minutes after the final detonation. The purpose of this search is to look for evidence of injury to marine life, including fish kills. Any other unusual observation will be noted.

1.9 Geophysical surveys

1.9.1 Overview

1.9.1.1 It should be noted that if MBES are conducted in shallow waters (<200 m), (e.g. where the Mona Offshore Wind Project will be located), the primary and tertiary mitigation (in form of pre-surveying search and soft starts) will not be required (JNCC, 2017).

1.9.1.2 The exact type of equipment to be used post consent is unknown, with a range of survey techniques presented in Table 1.11. None of the sources are airguns, and therefore will align with guidance on sonar-like sources (MBES, SSS, SBES and SBP) and sparker impulsive sources (UHRS), with the exact equipment presented in the final MMMP, in line with the JNCC (2017) guidelines.

1.9.1.3 It is recognised that Autonomous Surface Vehicles (ASV) are increasingly used for geophysical data acquisition (particularly for MBES/SBP surveys), and this will be detailed in final MMMP if applicable for relevant mitigation procedures. For example, with regard to visual monitoring, as an ASV transits to site it would be accompanied by a support vessel with MMO onboard and performs the required watch before the AUV switches on its systems. If there is a switch off, another MMO watch would be carried out (either by bringing an MMO out on a support vessel to the site or bringing the AUV back in to port). The measures described below therefore relate to surveys undertaken using conventional vessels.

1.9.2 Mitigation zone

1.9.2.1 Following the JNCC (2017) guidelines, a pre-survey monitoring of a zone at least 500 m in size should be conducted by MMOs in order to reduce the risk of marine mammals being present within this area. As the maximum predicted ranges for PTS are lower than 500 m across all species and geophysical survey techniques (Table 1.12), the standard 500 m mitigation zone will be sufficient to mitigate against injury (in terms of PTS) for all species.

1.9.2.2 MMOs should be present in sufficient numbers to ensure that monitoring is not compromised by fatigue. Prior to the commencement of the pre-survey monitoring, an individual who holds overall responsibility for geophysical survey operations (e.g. Chief Observer, see paragraph 1.6.5.1) will provide sufficient notice to the MMOs, PAM and ADD Operators prior to the scheduled commencement of survey operations. This advance notice will allow for an adequate time period for the survey and the soft start procedure.

1.9.3 Visual monitoring

1.9.3.1 As the geophysical surveys will be conducted in shallower waters (depth less than 200 m) MMOs will be required to conduct a pre-survey monitoring of at least 30 minutes prior to commencement of geophysical surveys as well as during the soft start procedure. The pre-survey monitoring would involve visual monitoring of the 500 m mitigation zone for the presence of marine mammals.

1.9.3.2 If a marine mammal is spotted within the mitigation zone during the MMO's pre-survey monitoring, the soft start procedure will be postponed until the MMO confirms that the marine mammal has left the mitigation zone and at least 20 minutes have passed since the last detection within the mitigation zone. The MMO should ensure that in situations where seals are congregating around a fixed platform within mitigation zone, the soft start should commence at a location at least 500 m from this congregation. Throughout the soft start phase, the MMO will continue to document any detections and observations of animal presence and behaviour.

1.9.3.3 The precise information pertaining to MMOs and the methods they employ will be revised and specified in the final MMMP, taking into consideration any updated guidance and available resources at the time.

1.9.4 Passive acoustic monitoring

1.9.4.1 The PAM will be conducted by PAM Operator in conjunction with visual monitoring during daylight operations as an additional measure to ensure effective detection of marine mammals within the mitigation zone.

1.9.4.2 During periods of limited visibility, such as night time, fog or high sea states above sea state 4, it will be necessary to conduct the monitoring of the mitigation zone using PAM due to a higher risk of failing to visually detect the presence of marine mammals under such conditions.

1.9.5 Soft start procedure

Sonar-like sources

1.9.5.1 In commencing a geophysical survey operation employing sonar-like sources (such as MBES, SSS, SBES), where it is possible according to the operational parameters of the equipment employed, the device's acoustic energy output should start from a lower energy output and be allowed to gradually build up to data acquisition output level over a minimum period of 20 minutes. The controlled build up of acoustic energy output should occur in consistent stages to provide a steady and gradual increase over the ramp up period. Where the gradual build up of acoustic energy is not possible according to the operational parameters of the equipment, the device should be switched on and off in a consistent sequential manner if possible with the equipment selected. The duration between activations should begin with a greater interval than is required for data acquisition, reducing over a period of 20 minutes to full necessary output.

1.9.5.2 In all cases where a soft start is employed the delay between the end of the soft start and the necessary full output must be minimised to prevent unnecessary high level sound introduction into the environment.

1.9.5.3 Once the soft start commences, there is no requirement to halt or discontinue the procedure if weather or visibility conditions deteriorate, nor if marine mammals occur

within the 500 m radial mitigation zone. Marine mammals present at this point are deemed to have entered the ensonified area willingly (JNCC, 2017).

Impulsive sources

1.9.5.4 The UHRS will utilise sparker sources, which produces an impulsive, broadband source signal. The JNCC (2017) guidance applies the same approach to sonar-like sources in this case (see paragraphs 1.9.5.1 to 1.9.5.3), i.e. where practical ramp up the power in a uniform manner.

1.9.6 During survey operation

1.9.6.1 Geophysical data are usually collected along predetermined survey lines. Line change or line turn is the term used to describe the activity of turning the vessel at the end of one survey line prior to commencement of the next.

1.9.6.2 The following procedures depend on the duration of the line change. If an operator determines that an effective line change cannot be achieved using these procedures, then they should contact the NRW and JNCC at the earliest possible opportunity to discuss a proposed alternative.

1.9.6.3 If monitoring operations are being undertaken using PAM and difficulties are encountered when deploying the PAM equipment, the line changes should be extended to allow the full pre-survey monitoring and soft start to be completed using PAM.

1.9.6.4 If a line turn is to be more than 40 minutes it must cease all activity at the end of the survey line. If power is shut down completely, the pre-monitoring measures and soft start procedures will be followed as for start up.

1.9.6.5 If line changes are expected to be completed within 40 minutes, the equipment can continue firing (although potentially at reduced power), if this is feasible due to the equipment selected (as detailed in the final MMMP).

1.9.6.6 These procedures must be agreed with NRW and will be detailed in the final MMMP.

1.9.7 Breaks in operations

Unplanned breaks

1.9.7.1 This refers to instances where the survey equipment ceases operation unexpectedly during data acquisition, (e.g. a technical problem or breakdown). In such circumstances, and as detailed in the JNCC guidance (2017), it is imperative the MMOs/PAM Operator begin to monitor the mitigation zone as quickly as possible after an unplanned break has occurred.

Unplanned breaks of less than 10 minutes

1.9.7.2 If the survey equipment can be restarted and data acquisition resumed in less than 10 minutes, there is no requirement for a soft start and operations can recommence at the same power level as at prior to the break (or lower), provided no marine mammal(s) have been detected in the mitigation zone during the breakdown period.

1.9.7.3 If a marine mammal is detected in the mitigation zone during the breakdown period, the MMOs/PAM Operator will advise to delay recommencement of operations until their passage, or the transit of the vessel, results in the marine mammals being outside

of the mitigation zone. There must be a minimum of a 20 minute delay from the time of the last detection within the mitigation zone and a soft start must then be undertaken.

Unplanned breaks of longer than 10 minutes

1.9.7.4 If it takes longer than 10 minutes to restart the survey equipment, a full pre-survey monitoring and soft start should be carried out before the survey recommences. If an MMO/PAM Operator has been monitoring during the breakdown period, this time can contribute to the pre-survey monitoring time (30 minutes).

1.9.7.5 If the breakdown occurs at night or during daylight conditions not conducive for a visual search, the mitigation zone should be monitored as described above using PAM. If PAM is not available, the survey must be delayed until conditions are suitable for visual observations.

Planned breaks

1.9.7.6 If breaks in data acquisition other than during a line change are required (e.g. to avoid a structure), these should be considered within the application to allow NRW and relevant SNCBs to fully understand the survey procedure.

1.9.7.7 The same procedures as described for unplanned breaks above can be applied. However, if the planned break will be for less than 10 minutes, the MMO/PAM Operator must begin monitoring 20 minutes prior to the planned break and continue for the duration of the break.

1.10 Reporting

1.10.1 Piling

1.10.1.1 A mitigation compliance report outlining the piling activity and measures for mitigating its impact will be prepared. This report may encompass, but is not limited to, the following:

- Brief details of the company awarded the consent or licence, relevant contractor details if appropriate, and the survey consent or licence reference number
- Details of any piling specific arrangements agreed with NRW as part of the consent conditions
- An overview of the methodology and procedures used for monitoring marine mammals (which includes details of PAM system technical specifications, configuration and expected detection performance for each marine mammal species expected to be encountered)
- A record of piling operations, specifying dates, soft start duration, piling duration, hammer energy during soft start and piling, and any operational issues for each pile
- Documentation of ADD deployment, indicating the start and end times of all ADD activation periods and any deployment issues
- Notations of marine mammal observations and PAM detections, including the duration of the pre-piling monitoring and soft starts

- Information about environmental conditions during the pre-piling monitoring, descriptions of marine mammal sightings or PAM detections, any actions taken in response, and records of incidental sightings outside of the pre-piling search
- Details of any problems encountered during the piling process, such as instances of noncompliance with the agreed piling protocol
- Where it has been possible to do so, data collected using the PAM system during piling operations will be submitted to the Marine Noise Registry and will include:
  - Source properties
  - Maximum hammer energy
  - Actual location of activity
  - Latitude/longitude point (decimal degrees)
  - Actual dates on which activity took place in correspondence with the location.

1.10.1.2 The final report will be submitted to NRW after construction activity is completed. It will be accompanied by completed JNCC marine mammal recording forms in the original format (i.e. the raw data in the excel spreadsheets) and a copy of the relevant survey consent or licence.

1.10.1.3 Any further additional mitigation measures, if required (i.e. the primary and tertiary measures adopted in this MMMP do not fully mitigate significant effects), will be detailed in the UWSMS (an Outline Underwater sound management strategy is included as part of the application, Document Reference J16).

1.10.2 UXO clearance

1.10.2.1 A mitigation compliance report outlining the UXO clearance activity and measures for mitigating its impact will be prepared. This report may encompass, but is not limited to, the following:

- Brief details of the company awarded the consent or licence, relevant contractor details if appropriate, and the survey consent or licence reference number
- Identification of all confirmed UXO, including estimated size, type, location and depth
- Approach taken for each UXO, including dates, times, disposal method attempted (based on size and type, and number of donor charge(s) used)
- Details of any UXOs relocated or if any UXOs larger than 130 kg are identified
- Presence, location, and activity of vessels during UXO clearance
- Outcome of each UXO clearance, including evidence of high-order detonation, clearing charges required, and method of debris and residue recovery
- The mitigation procedures followed for each UXO clearance, including details of MMO activities, PAM equipment and operation (including expected detection performance for the various species expected to be encountered), ADD duration and size and timing of soft start charges where required
- All marine mammal sightings and completed JNCC marine mammal recording forms

- Detailed descriptions of any technical problems encountered and what, if any, actions were taken as well as instances of non-compliance with the JNCC (2010b) guidelines, MMMP, and variations from agreed procedures
- Protocols followed and any recommendations which could benefit future projects.

1.10.2.2 The final report will be submitted to NRW after UXO clearance activity is completed. It will be accompanied by completed JNCC marine mammal recording forms in the original format (i.e. the raw data in the excel spreadsheets) and a copy of the relevant survey consent or licence.

1.10.2.3 Any further additional mitigation measures, if required (i.e. the primary and tertiary measures adopted in this MMMP do not fully mitigate significant effects), will be detailed in the UWSMS (an Outline Underwater sound management strategy is included as part of the application, Document Reference J16).

1.10.3 Geophysical surveys

1.10.3.1 A mitigation compliance report outlining the geophysical survey activity and measures for mitigating its impact will be prepared. This report may encompass, but is not limited to, the following:

- The company awarded the consent or licence, relevant contractor details if appropriate, and the survey consent or licence reference number
- Details of any survey specific arrangements agreed with NRW as part of the consent conditions
- Summary of the survey, including dates, location, co-ordinates and transects of survey, survey type and equipment used
- The average duration of all pre-survey monitoring, soft starts and line changes, and the number of occasions when guideline durations were not met
- Any problems encountered and instances of non compliances with the JNCC (2017) guidelines, MMMP, and variations from agreed procedures
- Details of the number of MMO/PAM Operators employed, monitoring effort, summary of MMO/PAM activities for each monitoring period, including specifics of the conducted surveys and any relevant observations on the efficacy of PAM equipment and expected detection performance for each species expected to be encountered
- Number and types of vessels involved in the survey and presence, location, and activity of other vessels during geophysical surveying
- Descriptions of any technical problems encountered and what, if any, actions were taken.

1.10.3.2 The final report will be submitted to NRW after construction activity is completed. It will be accompanied by completed JNCC marine mammal recording forms in the original format (i.e. the raw data in the excel spreadsheets) and a copy of the relevant survey consent or licence.

1.11 Next steps

1.11.1.1 The Applicant will update the final MMMP post-consent once further information and details on project design and programme are confirmed (e.g. UXO sizes confirmed by geophysical surveys of the Mona Array Area and Mona Offshore Cable Corridor and

Access Areas). The Final MMMP will be agreed with NRW prior to commencement of construction, and will contain a more detailed assessment and confirmation of appropriate mitigation measures available at the time of construction for Mona Offshore Wind Project.

1.12 References

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