

Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2)

Protected Species Monitoring and Mitigation Plan

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ACRONYMS AND ABBREVIATIONS

Empire Wind	Empire Offshore Wind, LLC
BOEM	Bureau of Ocean Energy Management
dB	decibel
DMA	Dynamic Management Area
ECM	Environmental Compliance Monitor
ESA	Endangered Species Act
ft	feet
HDD	horizontal directional drilling
HRG	high-resolution geophysical
Hz	hertz
IR	infrared
kHz	kilohertz
km	kilometer
km/hr	kilometer per hour
Lease Area	designated Renewable Energy Lease Area OCS-A 0512
m	meter
MMPA	Marine Mammal Protection Act
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	NOAA's National Marine Fisheries Service
PAM	passive acoustic monitoring
Project	The offshore wind projects for OCS A-0512 proposed by Empire Offshore Wind LLC, consisting of Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2).
PSO	Protected Species Observer
SMA	Seasonal Management Area

1. INTRODUCTION

Empire Offshore Wind LLC (Empire Wind) proposes to construct and operate an offshore wind farm consisting of Empire Wind 1 and Empire Wind 2 (collectively, the Project) located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area; **Figure 1**) and in coastal waters where the submarine export cable routes will be established. The lease area and collective coastal waters associated with the submarine export cable routes comprise the Project Area. Empire Wind intends to use high-resolution geophysical (HRG) survey equipment during survey activities in support of the Project; Empire Wind also intends to use impact pile driving to install wind turbine generator (wind turbine) foundations and offshore substation foundations, and to use vibratory pile driving to install and remove temporary cofferdams to support horizontal directional drilling (HDD) at the export cable landfall of the submarine export cables during offshore Project construction and marina construction activities.

Both the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) have advised that construction activities (including impact pile driving and vibratory driving) and sound producing HRG survey equipment operating below 180 kilohertz (kHz; e.g., sub-bottom profilers) have the potential to cause acoustic harassment to marine species, in particular marine mammals (NOAA Fisheries 2018a).

Empire Wind has committed to the following comprehensive set of monitoring and mitigation measures during marine construction and survey activities for the Project. Empire Wind also commits to engaging in ongoing consultations with NOAA National Marine Fisheries Service (NOAA Fisheries) regarding monitoring and mitigation protocols. The measures detailed in this document are designed to avoid and minimize potential impacts of Project-related activities on marine protected species.

2. MARINE PROTECTED SPECIES IN THE PROJECT AREA

Marine mammals inhabit all of the world's oceans and are found in coastal, estuarine, and pelagic habitats. There are 38 marine mammals (cetaceans and pinnipeds) found in the Northwest Atlantic Outer Continental Shelf region waters with documented ranges that include the Project Area. All 38 marine mammals listed in **Table 1** are protected by the Marine Mammal Protection Act (MMPA) and five are additionally federally listed as Endangered under the Endangered Species Act (ESA). Of those 38 species, there are 20 considered common (known to be present either year-round or seasonally in the Project Area); two of these are ESA-listed as Endangered: the North Atlantic right whale and the fin whale. There is no Critical Habitat for any marine mammal species in the Project Area. There are five species of sea turtles (**Table 2**) and four species of fish (**Table 3**) in the Project Area that are listed under the ESA as either threatened or endangered.

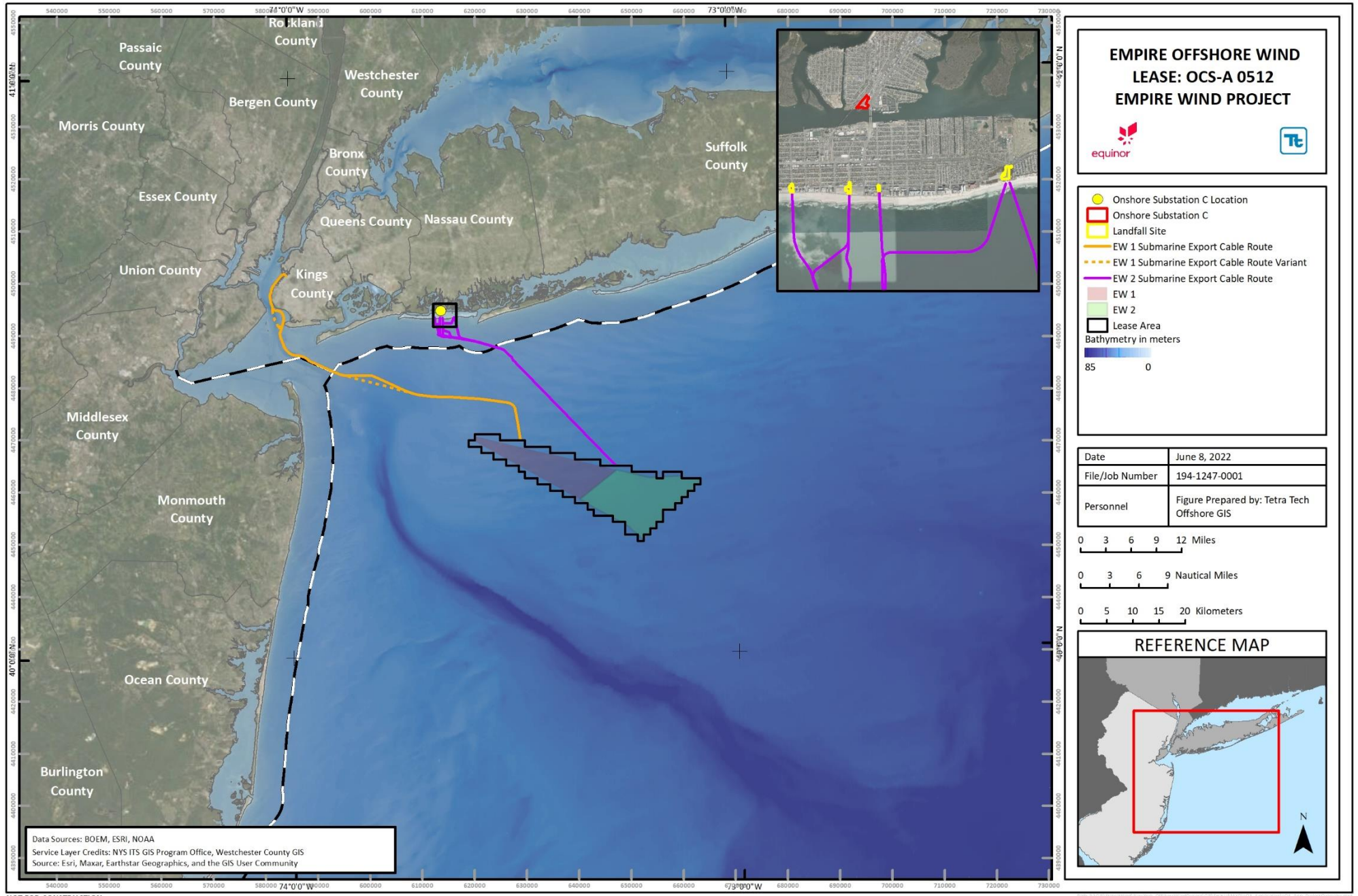


Figure 1 Empire Wind Project Area

Table 1 Marine Mammals Known to Occur in the Marine Waters in Coastal and Offshore New York

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Mysticetes (Baleen Whales)								
Balaenopteridae (Rorquals)								
Blue whale	<i>Balaenoptera musculus</i>	E	E	Unknown	W. North Atlantic	Not well known; primarily deep waters	Unlikely	Seasonal; Winter, Fall
Fin whale	<i>Balaenoptera physalus</i>	E	E	6,802	W. North Atlantic	Throughout	Common	Year-round
Humpback whale	<i>Megaptera novaeangliae</i>	E	MMPA	1,396	North Atlantic	Becoming more coastal; may be in inlets.	Common	Year-round
Minke whale	<i>Balaenoptera acutorostrata</i>	N/A	MMPA	21,968	Canadian E. Coast	On and over continental shelf	Common	Seasonal
Sei whale	<i>Balaenoptera borealis</i>	E	E	6,292	Nova Scotia	Continental shelf and slope waters; throughout	Uncommon	Seasonal; Winter, Spring, Fall
Balaenidae (Right and Bowhead Whales)								
North Atlantic right whale	<i>Eubalaena glacialis</i>	E	E	368	Western Atlantic	Primarily coastal	Common	Seasonal; Winter, Spring, Fall
Odontocetes (Toothed Whales)								
Phocoenidae (Porpoises)								
Harbor porpoise	<i>Phocoena</i>	SC	MMPA	95,543	Gulf of Maine / Bay of Fundy	Great South Bay	Common	Seasonal

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Physeteridae (Sperm Whales)								
Dwarf sperm whale	<i>Kogia sima</i>	N/A	MMPA	7,750	W. North Atlantic	Over outer continental shelf	Rare	Uncommon
Pygmy sperm whale	<i>Kogia breviceps</i>	N/A	MMPA	7,750	W. North Atlantic	Over continental slope	Rare	Uncommon
Sperm whale	<i>Physeter macrocephalus</i>	E	E	4,349	North Atlantic	Along and over continental shelf; around Montauk Point; Deep ocean waters	Unlikely	Year-round
Delphinidae (Dolphins)								
Atlantic spotted dolphin	<i>Stenella frontalis</i>	N/A	MMPA	39,921	W. North Atlantic	Primarily deeper waters	Common	Seasonal
Atlantic white-sided dolphin	<i>Lagenorhynchus acutus</i>	N/A	MMPA	93,233	W. North Atlantic	On continental shelf and slope	Common	Seasonal
Bottlenose dolphin (Western North Atlantic, Offshore)	<i>Tursiops truncatus</i>	N/A	MMPA	62,851	W. North Atlantic	Coastal and offshore	Common	Year-round
Bottlenose dolphin (Western North Atlantic, Northern Migratory Coastal)	<i>Tursiops truncatus</i>	N/A	MMPA	6,639	W. North Atlantic	Coastal and offshore	Common	Year-round

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Clymene dolphin	<i>Stenella clymene</i>	N/A	MMPA	4,237	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Common dolphin	<i>Delphinus delphis</i>	N/A	MMPA	172,974	W. North Atlantic	Coastal and offshore	Common	Year-round
False killer whale	<i>Pseudorca crassidens</i>	N/A	MMPA	1,791	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Killer whale	<i>Orcinus orca</i>	N/A	MMPA	Unknown	W. North Atlantic	Over continental shelf and rise; Open sea and offshore waters	Uncommon	Uncommon
Long-finned pilot whale	<i>Globicephala melas</i>	N/A	MMPA	39,215	W. North Atlantic	Over continental shelf to slope	Common	Year-round
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	N/A	MMPA	28,924	W. North Atlantic	Over continental shelf to slope	Uncommon	Uncommon
Northern bottlenose whale	<i>Hyperoodon ampullatus</i>	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Pantropical spotted dolphin	<i>Stenella attenuata</i>	N/A	MMPA	6,593	W. North Atlantic	Primarily deeper waters	Common	Year-round
Pygmy killer whale	<i>Feresa attenuata</i>	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Risso's dolphin	<i>Grampus griseus</i>	N/A	MMPA	35,215	W. North Atlantic	Along continental slope	Common	Year-round
Rough-toothed dolphin	<i>Steno bredanensis</i>	N/A	MMPA	136	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Spinner dolphin	<i>Stenella longirostris</i>	N/A	MMPA	4,102	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Striped dolphin	<i>Stenella coeruleoalba</i>	N/A	MMPA	67,036	W. North Atlantic	Over continental slope	Common	Seasonal
White-beaked dolphin	<i>Lagenorhynchus albirostris</i>	N/A	MMPA	536,016	W. North Atlantic	On and over continental shelf	Rare	Uncommon
Ziphiidae (Beaked whales)								
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	N/A	MMPA	5,744	W. North Atlantic	Deep ocean waters	Common	Seasonal
Gervais' beaked whale	<i>Mesoplodon europaeus</i>	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Sowerby's beaked whale	<i>Mesoplodon bidens</i>	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
True's beaked whale	<i>Mesoplodon mirus</i>	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Sirenia (Sea cows)								
Trichechidae (Manatees)								
West Indian manatee	<i>Trichechus manatus</i>	N/A	T	3,802	Florida	Freshwater, estuarine, and extremely nearshore coastal areas	Extralimital	Uncommon

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Pinnipeds (eared and earless seals)								
Phocidae (earless seals)								
Gray seal	<i>Halichoerus grypus</i>	N/A	MMPA	27,131	W. North Atlantic	Coastal and continental shelf waters	Common	Seasonal
Harbor seal	<i>Phoca vitulina</i>	N/A	MMPA	75,834	W. North Atlantic	Coastal, bays, estuaries, inlets	Common	Seasonal
Harp seal	<i>Cystophora cristata</i>	N/A	MMPA	Unknown	W. North Atlantic	Continental shelf with pack ice	Rare	Uncommon
Hooded seal	<i>Phoca groenlandica</i>	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean water at edge of continental shelf with pack ice	Rare	Uncommon

Source: Hayes et al. 2022.

Notes:

a/ SC = Species of Concern; E = Endangered; T = Threatened; MMPA = Marine Mammal Protection Act; N/A = not applicable

b/ This is a total estimate for all Mesoplodon spp.

Table 2 Sea Turtles Species Known to Occur in the Project Area

Name	Species Name	New York Status	Federal Status	Estimated Population	Known New York and New Jersey Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence
Atlantic (Kemp's) Ridley	<i>Lepidochelys kempii</i>	E	E	N/A	Nearshore	Common	Spring to Fall with peak in Summer
Loggerhead	<i>Caretta</i>	T	T	588,000	Nearshore and Offshore (Continental Shelf)	Common	Spring to Fall with peak in Summer

Name	Species Name	New York Status	Federal Status	Estimated Population	Known New York and New Jersey Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence
Green	<i>Chelonia mydas</i>	T	T a/	N/A	Coastal	Regular, less common	Spring to Fall with peak in Summer
Leatherback	<i>Dermochelys coriacea</i>	E	E	20,000-30,000	Coastal; and Offshore (Continental Shelf)	Common	Spring to Fall with peak in Summer
Atlantic Hawksbill	<i>Eretmochelys imbricate</i>	E	E	N/A	Unlikely – northern reach of range	Unlikely/Rare	Summer

Sources: Shoop and Kenney 1992; UDSG 2000; Bass and Witzell 2000; DoN 2005; NYSDOS 2013; NYSERDA 2017, NYSDEC 2018; NOAA Fisheries 2019a,b,c; APEM and Normandeau Associates 2018

Notes:

E = endangered, T = threatened

a/ Green sea turtle juveniles from the threatened population of the North Atlantic District Population Segment are most common

Table 3 Protected Fish Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status a/	New York Status a/	Likelihood of Occurrence b/
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>	E	CI	High
Shortnose sturgeon	<i>Acipenser brevirostrum</i>	E	E	Low
Giant manta ray	<i>Manta birostris</i>	T	-	Low
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	T	-	Low

Sources: NOAA Fisheries 2018b, NYSDEC 2019

Notes:

a/ Species Status: CI = Critically Imperiled; E = Endangered; T =Threatened

b/ The likelihood of occurrence was informed by field observations, consultation with federal and state agencies, and available literature. Low – The species is uncommon or generally absent from Project Area, but marginally suitable habitat is present; Moderate – The species is uncommon but known to occur in Project Area and suitable habitat is present.

3. PROTECTED SPECIES OBSERVER (PSO) AND PASSIVE ACOUSTIC MONITOR (PAM) OPERATOR REQUIREMENTS

A briefing will be conducted between the supervisors and crews, the Protected Species Observers (PSOs), Environmental Compliance Monitors (ECMs), and Empire Wind at the outset of the Project. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures. A Lead PSO will be designated who will oversee the execution of the training, the ECM, the other PSOs, and other monitoring related duties.

3.1 PSO Requirements

All PSOs will be qualified and NOAA Fisheries-approved third-party PSOs. PSO qualifications will include a science degree and direct field experience on a marine mammal/sea turtle observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. The resumes, PSO training certifications, and NOAA Fisheries approval letters of all proposed PSOs will be submitted to BOEM for review and approval at least two weeks prior to the start of activities requiring monitoring.

All PSOs will receive the additional environmental training that will be provided to all crew prior to the start of required monitoring activities, and during any changes in crew, such that all personnel are fully aware of and understand the mitigation, monitoring, and reporting requirements. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the activities requiring monitoring. The training program will be provided to NOAA Fisheries for review and approval prior to the start of these activities.

3.2 Environmental Compliance Monitor Requirements

Trained crew observers will act as ECMs in support of activities for which a third-party PSO is not required (e.g., crew vessel transits). An ECM must be an experienced crew member who has participated in the environmental training program that will be provided prior to the start of activities. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the activities requiring monitoring. This training program will include marine protected species identification as well as vessel strike avoidance protocols to ensure the ECM can sufficiently monitor for the presence of marine protected species and ensure compliance with NOAA Fisheries mitigation, monitoring, and reporting requirements.

3.3 PAM Operator Requirements

All passive acoustic monitoring (PAM) operators will have completed a BOEM/NOAA Fisheries approved PSO training program in addition to a PAM training course. PAM operators will have relevant observation experience in the Atlantic or Gulf of Mexico. The resumes of all proposed PSOs and PAM operators will be submitted to BOEM for review and approval by NOAA Fisheries at least one week prior to the start of mitigation and monitoring activities.

PAM operators will have the qualifications and relevant experience to meet the needs of the PAM program, including safe deployment and retrieval of equipment as necessary, set-up and monitoring of acoustic processing software, and knowledge in detecting and localizing marine mammal vocalizations. Like the PSO team, the PAM team will have a lead monitor (Lead PAM Operator) who will have experience in the Atlantic

Ocean on similar projects. The remaining PAM operators will have previous PAM experience on similar projects and the ability to work with the relevant software and equipment.

In addition to the training indicated above, PAM operators will also complete a two-day training and refresher session with the PSO provider and Project compliance representative(s). The two-day training will review in detail the protected species expected in the Project Area and associated regulatory requirements, and it will be conducted shortly before the anticipated start of Project activities. The refresher session will be tailored to the needs of the particular PAM team and will consider what field projects the PAM operators have recently been on.

4. PSO AND PAM PROTOCOLS

In the two days prior to the start of applicable construction activities, and daily throughout applicable construction activities, the Lead PSO of the monitoring team will consult NOAA Fisheries North Atlantic right whale reporting systems and monitor WhaleAlert software for the presence of North Atlantic right whales. The proposed activities will occur within the vicinity of the Right Whale Port of New York – New Jersey Seasonal Management Area (SMA). Activities conducted between November 1 and April 30 will need to comply with the seasonal mandatory speed restriction period for this SMA for any work or transit within this area. Pile driving of foundations will not occur from January 1 through April 30. In addition, pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical issues arise that necessitate extending pile driving into December, in which case Empire Wind will notify NOAA Fisheries and BOEM in writing by September 1 that circumstances are expected to necessitate pile driving in December.

Throughout all phases of the survey activities, Empire Wind will monitor NOAA Fisheries North Atlantic right whale reporting systems for the establishment of a Dynamic Management Area (DMA). If NOAA Fisheries should establish a DMA in the Project Area, within 24 hours of the establishment of the DMA Empire Wind will consult with NOAA Fisheries to determine which actions are necessary, including a potential alteration of vessel-based activities to avoid the DMA.

Pile-driving associated with cable landfall and marina construction activities will only occur during daylight hours and will therefore not necessitate PAM.

4.1 Staffing for Foundation Installation Activities

4.1.1 Roles and Responsibilities during Foundation Construction

During construction operations (impact piling of foundations), a team of PAM Operators and PSOs will be on board the installation vessel and the secondary PSO-dedicated vessel to undertake visual and acoustic watches, implement mitigation, and conduct data collection and reporting. Dual-role PAM/PSOs will be allowed as necessary. The team will be of sufficient size to allow for two PSOs to be on duty on the installation vessel and two additional PSOs on duty on a PSO-dedicated vessel. Each PSO will be on duty for no more than a four-hour shift with at least a two-hour break in between each shift. No one PSO will be on duty for more than 12 hours during any 24-hour period.

4.1.1.1 Lead PSO / Lead PAM Operator

Prior to commencement of construction activities, a senior-level PSO and PAM operator will be designated Lead PSO and Lead PAM Operator, respectively, on each location/vessel. The Leads will be the main POCs for all communications between other Project or Vessel Managers and will ensure that all communication protocols are followed at all times during Project activities. The Leads will:

- Coordinate and oversee PAM and PSO Operations and ensure compliance with monitoring requirements;
- Acoustically monitor, detect, and identify marine mammals and determine distance to source;
- Record and report marine mammal sightings, construction activities, and environmental conditions according to plan;
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the plan;
- Communicate with the crew to implement mitigation actions as required by environmental protocols (including delays to initiation of all construction equipment);
- Maintain and troubleshoot the PAM system hardware and software;
- Oversee all deployments and retrievals of the hydrophone cable; and
- Participate in daily meetings and drills with crew when appropriate.

4.1.1.2 PAM Operator

All PAM operators will:

- Acoustically monitor, detect, and identify marine mammals and determine distance to source;
- Record and report marine mammal sightings, construction activities, and environmental conditions according to plan;
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements;
- Communicate with the crew to implement mitigation actions as required by environmental protocols;
- Assist Lead PAM Operator in maintaining and troubleshooting the PAM system hardware and software; and
- Oversee all deployments and retrievals of the hydrophone cable.

4.1.1.3 PSO

All PSOs will:

- Visually monitor, detect, and identify protected species;
- Record and report according to plan;
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the plan;
- Communicate with the crew to implement mitigation actions as required by environmental protocols; and
- Participate in daily operation meeting with crew when appropriate.

4.2 Staffing for Cable Landfall and Marina Construction Activities

4.2.1 Roles and Responsibilities during Cable Landfall and Marina Construction Activities

Pile-driving associated with the landfall and marina construction will only occur during daylight hours and will therefore not necessitate PAM staffing. During construction operations, a team of PSOs will be onboard the construction vessel to undertake visual and acoustic watches, implement mitigation, and conduct data collection and reporting. The team will be of sufficient size to allow for two PSOs to be on duty on the construction

vessel. Each PSO will be on duty for no more than a four-hour shift with at least a two-hour break in between each shift. No one PSO will be on duty for more than 12 hours during any 24-hour period.

4.3 Staffing for HRG Survey Activities

4.3.1 Roles and Responsibilities during HRG Survey Activities

A team of PSOs will be on board each vessel that will be conducting 24-hour survey operations to undertake visual watches, implement mitigation, and conduct data collection and reporting. The team will be of sufficient size to allow for one PSO to be on duty during daylight hours and two during nighttime hours. For each vessel that will be conducting 12-hour/daylight only survey operations, the team will be of sufficient size to allow for one PSO to be on duty during daylight hours. For all surveys, each PSO will be on duty for no more than a four-hour shift with at least a two-hour break in between each shift. No one PSO will be on duty for more than 12 hours during any 24-hour period.

4.3.1.1 Lead PSO

Prior to commencement of survey operations, a senior-level PSO will be designated Lead PSO on each location/vessel. The Lead PSO will be the main POC for all communications between other Project or Vessel Managers and will ensure that all communication protocols are followed at all times during Project activities. The Lead PSO will:

- Coordinate and oversee PSO operations and ensure compliance with monitoring requirements;
- Visually monitor, detect, and identify marine mammals and determine distance to source;
- Record and report marine mammal sightings, survey activities, and environmental conditions according to survey plan;
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the plan;
- Communicate with the crew to implement mitigation actions as required by environmental protocols (including delays to initiation of regulated survey equipment operating below 180 kHz); and
- Participate in daily meetings and drills with crew when appropriate.

4.3.1.2 PSO

All PSOs will:

- Visually monitor, detect, and identify protected species;
- Record and report according to survey plan;
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the survey plan;
- Communicate with the crew to implement mitigation actions as required by environmental protocols; and
- Participate in daily operation meeting with crew when appropriate.

5. PROTECTED SPECIES MONITORING AND MITIGATION ZONES

Note that for activities outside those explicitly discussed in Sections 5.1 through 5.3, a 10-meter shutdown zone will be implemented during use of heavy machinery to avoid potential impacts to marine mammals. This zone will be enforced by either an ECM or PSO.

5.1 Foundation Installation

Pre-clearance and Shutdown zones will be established and continuously monitored during impact pile driving to minimize impacts to marine mammals (**Table 4; Figure 2**). These zones will be monitored as described in Section 6.2 (Visual Monitoring Protocol) and mitigation enacted as described in 7.2.3 (Pre-clearance, Soft Start, and Shutdown Protocols). Impact pile driving will not be initiated in times when the visual clearance zones cannot be visually monitored, as determined by the lead PSO on duty.

Empire Wind proposes the following Pre-clearance and Shutdown zones for impact pile driving:

Table 4 Pre-clearance and Shutdown Zones for Impact Pile Driving

Species	Pre-clearance zone (m)	Shutdown zone (m)
North Atlantic right whale – PAM	5,000	1,500
North Atlantic right whale – visual detection	1,500	1,500
All other Mysticetes and sperm whales	1,500	1,500
Harbor porpoise	400	400
Dolphins and pilot whales	200	200
Seals	200	200

Note:
Pre-clearance and Shutdown zones will be the same for both typical and difficult-to-drive piles. Typical monopile foundations were analyzed for both 9.6-m and 11-m diameter piles at various embedment depths (see Section 6). “Difficult to drive” foundation locations would require higher hammer energies (for a full explanation please see Section 1.2.1 of the LOA application).

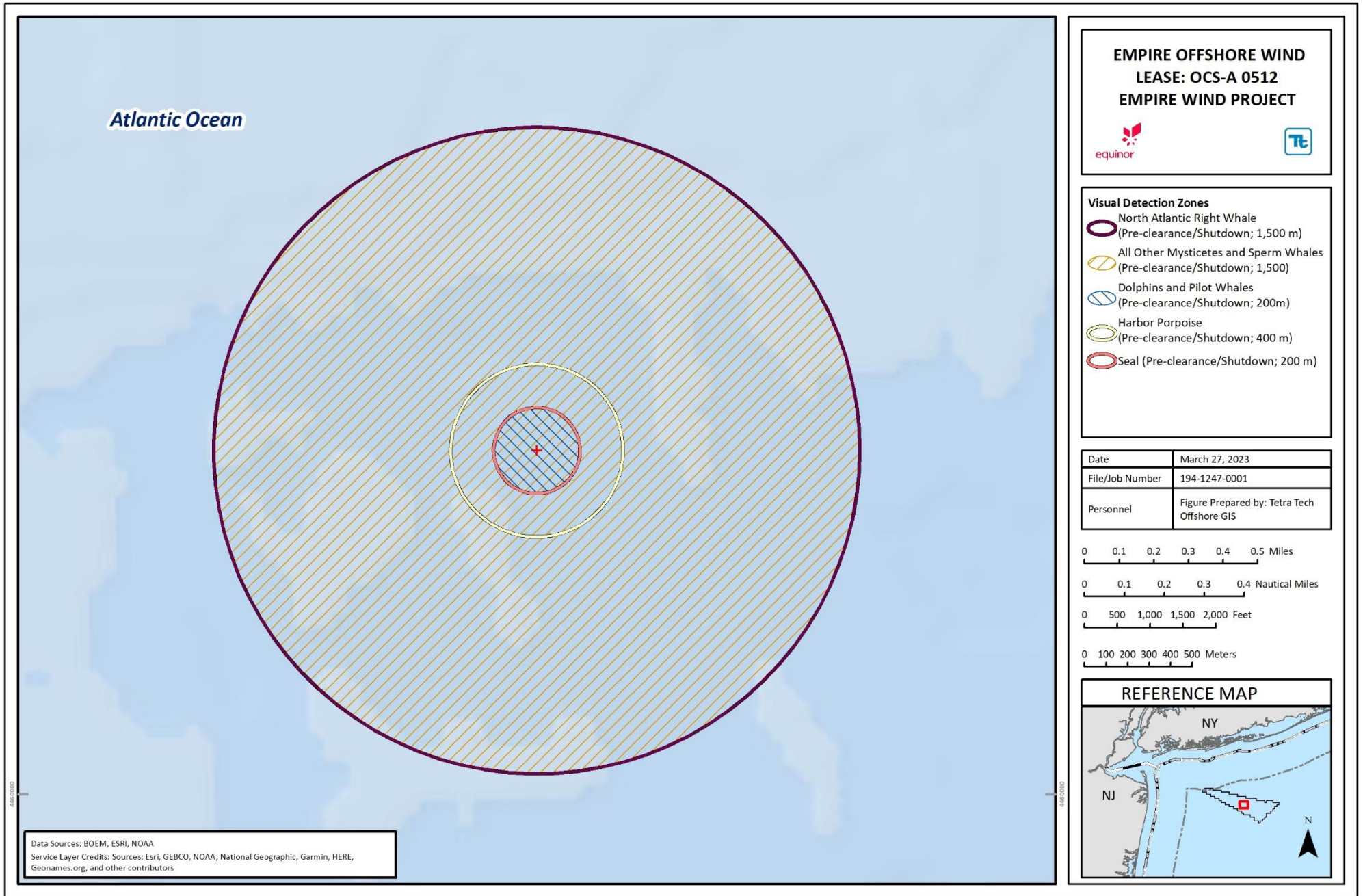


Figure 2 Visual Monitoring and Mitigation Zones for Foundation Installation

5.2 Cable Landfall and Marina Construction Activities

Pre-clearance and Shutdown zones for vibratory driving would be as follows (Table 5):

Table 5 Pre-clearance and Shutdown Zones for Cable Landfall and Marina Activities

Species	Pre-clearance Zone (m)	Shutdown Zone (m)
North Atlantic right whale, all other Mysticetes and sperm whale	1,600	1,600
Harbor porpoise	100	100
Dolphins and pilot whales	50	50
Seals	50	50
Sea Turtles	1,000	1,000

5.3 HRG Surveys

Pre-clearance and Shutdown zones for HRG survey activities with equipment that operates below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals will be determined based on best management practices as agreed to by NOAA Fisheries at the time the surveys are conducted. Proposed Pre-clearance and Shutdown zones are shown in Table 6.

Table 6 Pre-clearance and Shutdown Zones for HRG Survey Activities

Species	Pre-clearance Zone (m)	Shutdown Zone (m)
North Atlantic right whale	500	500
All other ESA-listed marine mammals (e.g., fin, sei, sperm whale)	500	100
All other marine mammal species a/	100	100
Sea Turtles	1,000	100

Note:

a/ With the exception of seals and delphinid(s) from the genera Delphinus, Lagenorhynchus, Stenella or Tursiops, as described below.

6. MONITORING EQUIPMENT AND PROTOCOLS FOR CONSTRUCTION ACTIVITIES

6.1 Visual Monitoring Equipment

PSOs will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to their established zones using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the sighting and monitoring of marine species. Digital single-lens reflex camera equipment will be used to record sightings and verify species identification. Position data will be recorded using hand-held or vessel global positioning system units for each sighting. Big Eyes binoculars will be used for monitoring during foundation installation.

6.1.1 Visual Monitoring Equipment during Low Visibility Conditions

During low visibility conditions, infrared (IR) imaging technology and night-vision equipment (if applicable) will be used. IR imaging has been investigated as a stand-alone detection method and an adjunct tool (i.e., in

addition to PSOs and/or PAM). For real-time detection, IR imaging is often combined with machine learning and automated detection software (Smith et al. 2020; Verfuss et al. 2018; Zitterbart et al. 2020). Specifications for proposed night-vision and IR equipment will be provided to NOAA Fisheries for review prior to the start of activities. Please refer to Section 8.3 for additional information.

6.2 Visual Monitoring Protocol

Observations will take place from the highest available vantage point and general 360-degree scanning will occur during the monitoring periods. Target scanning by the PSOs will occur when alerted of a marine mammal or sea turtle presence.

Data on all PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of survey operations; time of observation, location, and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior), and details of any observed “taking” (behavioral disturbances or injury/mortality). The data sheet will be provided to both NOAA Fisheries and BOEM for review and approval prior to the start of survey activities. In addition, for all construction activities and survey operations, members of the monitoring team will consult NOAA Fisheries North Atlantic right whale reporting systems between watch shifts for the presence of North Atlantic right whales throughout operations. Reporting systems will be checked at least once daily.

6.2.1 Foundation Installation

During impact pile driving visual monitoring will occur as follows:

- A minimum of two PSOs must be on active duty on the impact pile driving vessel/platform from 60 minutes before, during, and for 30 minutes after all pile installation activity; and
- A minimum of two PSOs must be on active duty on a dedicated PSO vessel from 60 minutes before, during, and for 30 minutes after all monopile installation activity, or, an alternate monitoring technology (e.g., UAS) that has been demonstrated as having greater visual monitoring capability compared to two PSOs on a dedicated PSO vessel and is approved by NOAA Fisheries, will be employed from 60 minutes before, during, and for 30 minutes after all monopile installation activity. If a dedicated PSO vessel is selected, the vessel must be located at the best vantage point in order to observe and document marine mammal sightings in proximity to the Pre-clearance/Shutdown zones.

6.2.2 Cable Landfall and Marina Construction Activities

A minimum of two PSOs will be on active duty on the vibratory pile driving platform, or on a vessel or vantage point nearby the construction vessel, from 30 minutes before, during, and 30 minutes after all pile driving.

6.2.3 HRG Survey Activities

A minimum of one PSO on active duty during the day and two PSOs on active duty at night will be stationed aboard either the survey vessel or a dedicated PSO vessel when active acoustic sources that operate below 180 kHz and that have been determined by NOAA Fisheries as likely to result in harassment of marine mammals, are operated. The PSO must be on active duty from 30 minutes before, during, and 30 minutes after end of operation of such equipment.

Observations will take place from the highest available vantage point on the pile driving platform, dedicated PSO vessel, or HRG survey vessel (depending on activity). General 360-degree scanning will occur during the

monitoring periods, and target scanning by the PSO will occur when alerted of a marine mammal or sea turtle presence.

6.3 Acoustic Monitoring Equipment

PAM will occur during all foundation installation activities and will supplement the visual monitoring program. The PAM system will be designed and established such that detection capability extends to at least 5 kilometers (km) from the pile driving location, though it will extend farther if available technology at the time of construction allows, for all foundation installations. The PAM system will offer real-time detection of low-frequency cetaceans, targeting a frequency range of approximately 20 hertz (Hz) (corresponding to the ‘gunshot’ frequency of North Atlantic right whales [Van Parijs et al. 2021] to 1,500 Hz (the upper limit of the core detection bandwidth for humpback whales [Van Parijs et al. 2021]). A focus will be placed on detecting the core detection bandwidth for North Atlantic right whales, 65-400 Hz (Van Parijs et al. 2021). Note that while these are the target frequencies, the actual detection bandwidth will vary based on the subcontractor selected and available technology at the time of deployment. Systems that offer localization will be preferred over those that do not; however, incorporation of this capability will depend on the system ultimately selected. Stationary surface vehicles, fixed surface buoys, and/or gliding autonomous vehicles may also be considered pending additional analysis of their utility and practicality. Towed systems, while under consideration, are not preferred due to the potential for masking by vessel noise from the towing vehicle. Bottom-mounted, fixed systems are also not preferred as most of these systems only offer archival detection, though any real-time options will be taken under consideration. Drifter systems are not under consideration as their location is not fixed. The system will also consider species-specific automated detection software options if feasible and will archive all data in a publicly available fashion and report to the Northeast Passive Acoustic Reporting System via nmfs.pacmdata@noaa.gov following ISO standards for required detection, measurement, and metadata information.

6.4 Passive Acoustic Monitoring Protocols

6.4.1 Foundation Installation

During foundation installation, PAM will begin 60 minutes prior to the initiation of soft start, throughout foundation installation, and for 30 minutes after pile driving has been completed. PAM will be conducted by a dedicated, qualified, and NOAA Fisheries-approved PAM operator.

The PAM operator(s) will monitor the hydrophone signals in real-time both aurally (using headphones) and visually (via the monitor screen displays). PAM operators will communicate detections of any marine mammals to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measures (i.e., delay or shutdown of pile driving). PAM detection alone (i.e., in the absence of visual confirmation by a PSO of a marine mammal within a relevant Pre-clearance/Shutdown zone) will not trigger mitigation measures (i.e., delay or shutdown of pile driving), with the exception of a confirmed PAM detection of a North Atlantic right whale within the relevant zone (**Table 4**).

The real-time PAM system will be configured to ensure that the PAM operator is able to review acoustic detections within approximately 15 minutes of the original detection, in order to verify whether a right whale has been detected. Any possible right whale vocalization will be reported as a detection if the vocalization is determined by the PAM operator to be within the Pre-clearance/Shutdown zones (**Figure 3**). Please note: **Figure 3** shows PAM clearance and shutdown zones and is not meant to show the actual configuration of hydrophones for PAM coverage; the configuration of hydrophones for PAM coverage is being developed and will be provided to NOAA Fisheries prior to construction.

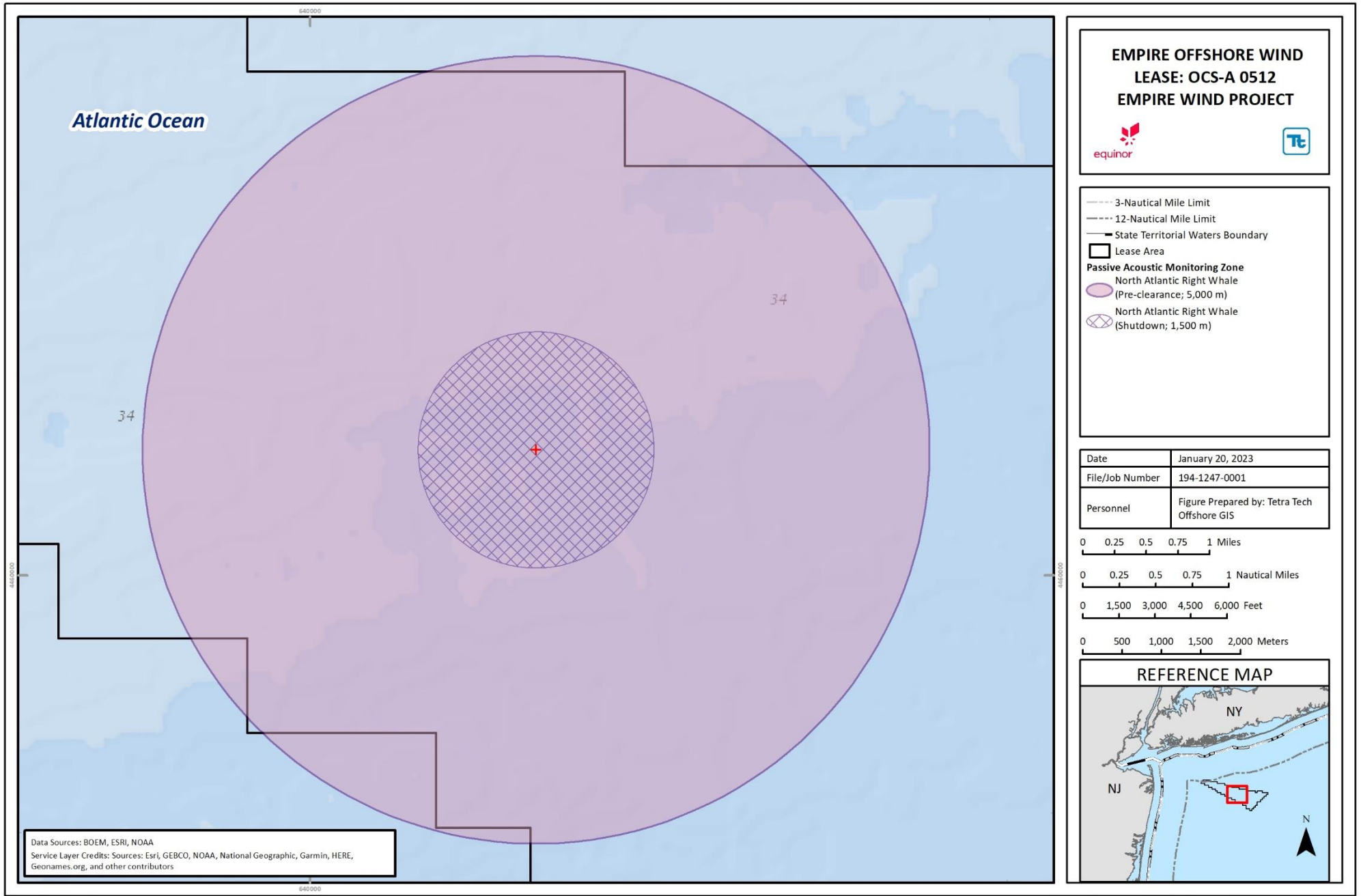


Figure 3 Passive Acoustic Monitoring Zones

6.4.2 Cable Landfall and Marina Construction Activities

Passive acoustic monitoring will not be implemented during cable landfall and marina construction activities.

6.4.3 HRG Survey Activities

Passive acoustic monitoring will not be implemented during HRG survey activities.

7. MITIGATION MEASURES FOR PROTECTED SPECIES

Per the conditions outlined in Lease No. OCS-A 0512, Empire Wind has committed to the following comprehensive set of mitigation measures during marine construction and surveys for the Project; Empire Wind also commits to engaging in ongoing consultations with NOAA Fisheries. The mitigation procedures outlined in this section are designed in consideration of the most recent scientific information available regarding protected species' habitat use and acoustic presence (Murray et al. 2022; Chou et al. 2022; King et al. 2021). Unless otherwise specified, the following mitigation measures apply to Project offshore construction activities.

7.1 Vessel Strike Avoidance Procedures

Empire Wind will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to, the following, except under extraordinary circumstances when complying with these measures would put the safety of the vessel or crew at risk:

- a. All vessel operators and crew will maintain vigilant watch for cetaceans, pinnipeds, and sea turtles and slow down or stop their vessel to avoid striking these protected species;
- b. All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions in any SMA, DMA or visually triggered Slow Zone. Empire Wind notes that NOAA Fisheries has proposed revisions to the vessel speed rules to protect North Atlantic right whales, including potential revisions to SMAs, DMAs and Slow Zones. To the extent the proposed revisions to the rule become finalized, Empire Wind may adjust this proposed mitigation measure;
- c. All vessel operators will reduce vessel speed to 10 knots (18.5 km/hr) or less when any large whale, any mother/calf pairs, whale or dolphin pods, or larger assemblages of cetaceans are observed near (within 100 meters [m 330 feet (ft)]) an underway vessel;
- d. All vessels will maintain a separation distance of 500 m (1,640 ft) or greater from any sighted North Atlantic right whale;
- e. If underway, vessels must steer a course away from any sighted North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 m (1,640 ft) minimum separation distance has been established. If a North Atlantic right whale is sighted in a vessel's path, or within 100 m (330 ft) of an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 100 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m;
- f. All vessels will maintain a separation distance of 100 m (330 ft) or greater from any sighted whales. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and beyond 100 m. If a vessel is

stationary, the vessel will not engage engines until the whale has moved out of the vessel's path and beyond 100 m;

- g. All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted small cetaceans. Any vessel underway remain parallel to a sighted small cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Vessels may not adjust course and speed until the small cetaceans have moved beyond 50 m and/or the abeam of the underway vessel;
- h. All vessels underway will not divert or alter course in order to approach any whale, small cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and
- i. All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped.
- j. A monitoring and vessel strike avoidance zone of 500 m in all directions will be maintained for ESA-listed fish species. If any ESA-listed fish species is sighted, vessels will decrease speed to 10 knots or less (4 knots for water depths less than 4 feet) and steer away from the animal. Data on the sighting will be recorded and reported as per the Lease conditions.

Vessel operators will use all available sources of information on North Atlantic right whale presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and monitoring of Coast Guard VHF Channel 16 to receive notifications of right whale detections to plan vessel routes to minimize the potential for co-occurrence with right whales.

7.2 Mitigation Measures for Foundation Installation Sound Sources

Visual monitoring will be maintained as per Visual Monitoring Protocol in Section 6.2. Empire Wind will employ noise mitigation techniques during all impact pile driving that will attenuate pile driving noise by a minimum of 10 decibels (dB), such that measured ranges to isopleth distances corresponding to relevant marine mammal harassment thresholds are consistent with those modeled based on 10 dB attenuation, determined via sound field verification (Section 8.1). Note that given the rapid advancement in technologies and potential for additional attenuation as technology evolves, Empire Wind will review suitable technologies available at the time of installation before selecting a final device.

7.2.1 Seasonal Pile Driving Restrictions

Impact pile driving of foundations will not occur from January 1 through April 30. In addition, pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical issues arise that necessitate extending pile driving into December in which case Empire Wind would notify NOAA Fisheries and BOEM in writing by September 1 that circumstances are expected to necessitate pile driving in December.

7.2.2 Pile Driving Weather and Time Restrictions

Impact pile driving will commence only during daylight hours no earlier than one hour after (civil) sunrise. Impact pile driving will not be initiated later than 1.5 hours before (civil) sunset. Pile driving may continue after dark when the installation of the same pile began during daylight (1.5 hours before (civil) sunset), when Pre-clearance zones were fully visible (though visual, IR or surveillance technology) for at least 30 minutes and must proceed for human safety or installation feasibility reasons. Impact pile driving will not be initiated in times of low visibility when the visual clearance zones (Section 6.2) cannot be visually monitored, as determined by the lead PSO on duty.

7.2.3 Pre-clearance, Soft Start, and Shutdown Protocols

7.2.3.1 Pre-clearance Procedures

For both impact and vibratory pile driving, Empire Wind will implement a 60-minute pre-start clearance period of the Pre-clearance zones prior to the initiation of soft-start to ensure no marine mammals or sea turtles are in the vicinity of the pile. During this period, the Pre-clearance zones will be monitored by both PSOs and PAM. Pile driving will not be initiated if any marine mammal is observed within its respective Pre-clearance zone (**Table 4**). If a marine mammal is observed within a Pre-clearance zone during the pre-start clearance period, impact pile driving may not begin until the animal(s) has been observed exiting its respective zone, or, until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). In addition, impact pile driving will be delayed upon a confirmed PAM detection of a North Atlantic right whale, if the PAM detection is confirmed to have been located within the 5-km North Atlantic right whale PAM Pre-clearance zone. Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a North Atlantic right whale.

Impact pile driving will not be initiated if the Pre-clearance zones cannot be adequately monitored (i.e., if they are obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period prior to the commencement of soft start, as determined by the Lead PSO. If light is insufficient, the lead PSO will call for a delay until the Pre-clearance zone is visible in all directions. If a soft start has been initiated before the onset of inclement weather, pile driving activities may continue through these periods if deemed necessary to ensure human safety and/or the integrity of the Project.

7.2.3.2 Soft Start Procedures

A soft start refers to initiating the pile driving process at reduced hammer energy to provide marine mammals a warning and an opportunity to vacate the area prior to pile driving at full hammer energy. Soft start will occur at the beginning of impact pile driving of each pile and at any time following the cessation of impact pile driving of 30 minutes or longer. The soft start requires an initial 30 minutes using a reduced hammer energy for pile driving. A soft start is not possible with vibratory pile driving.

7.2.3.3 Shutdown Procedures

The Pre-clearance and Shutdown zones around the pile driving activities will be maintained, as previously described, by PSOs for the presence of marine mammals before, during, and after impact pile driving activity. If a marine mammal is observed entering or within the respective zones after pile driving has commenced, a shutdown of impact pile driving will occur when practicable as determined by the lead engineer on duty, who must evaluate the following to determine whether shutdown is safe and practicable:

- a. Use of site-specific soil data and real-time hammer log information to judge whether a stoppage would risk causing piling refusal at re-start of piling;
- b. Confirmation that pile penetration is deep enough to secure pile stability in the interim situation, taking into account weather statistics for the relevant season and the current weather forecast; and
- c. Determination by the lead engineer on duty will be made for each pile as the installation progresses and not for the site as a whole.

If a shutdown is called for but the lead engineer determines shutdown is not practicable due to an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy (power down) will be implemented, if and when the lead engineer determines it is practicable.

Following a shutdown due to a marine mammal approaching or within the shutdown zone, subsequent restart/increased power of the equipment can be initiated if the animal has been observed exiting its respective zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species).

If pile driving shuts down for reasons other than mitigation (e.g., mechanical difficulty) for brief periods (i.e., less than 30 minutes), it may be activated again without ramp-up, if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective zones. If a shutdown occurs for reasons other than mitigation (e.g., mechanical difficulty) pile driving of the same pile may resume immediately at full power (i.e., the pre-start clearance period may not occur) if the lead engineer determines that a pre-start clearance period and/or ramp-up of energy prior to re-start of pile driving of the same pile is not practicable due to an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life to an individual.

7.3 Mitigation Measures for Cable Landfall and Marina Construction Activities

Visual monitoring will be maintained as per Visual Monitoring Protocol in Section 6.2.

7.3.1 Pre-clearance Procedures

For all pile driving, Empire Wind will implement a 30-minute clearance period of the Pre-clearance zones (Section 5.2) prior to the initiation of installation. During this period the Pre-clearance zones will be monitored by the PSOs, using the appropriate visual technology for a 30-minute period. Installation may not be initiated if any marine mammal is observed within its respective Pre-clearance zone. If a marine mammal is observed within a Pre-clearance zone during the pre-start clearance period, installation may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a North Atlantic right whale.

7.3.2 Shutdown and Power Down Procedures

The Pre-clearance and Shutdown zones around pile driving activities will be maintained, as previously described, by PSOs for the presence of marine mammals or sea turtles before, during, and after pile driving activity. An immediate shutdown of the hammer will be required if a marine mammal is sighted within or approaching its respective Shutdown zone. The operator will comply immediately with any call for shutdown by the Lead PSO, except in cases where immediate shutdown would represent a human safety risk. Any disagreement between the Lead PSO and operator will be discussed only after shutdown has occurred. Subsequent restart of the equipment can be initiated if the animal has been observed exiting its respective Shutdown zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species).

7.4 Mitigation Measures for HRG Survey Sound Sources

In the two days prior to, and daily throughout operations, the Lead PSO of the monitoring team will consult NOAA Fisheries North Atlantic right whale reporting systems and monitor WhaleAlert software for the presence of North Atlantic right whales. The proposed activities will occur within the vicinity of the Right Whale Port of New York – New Jersey SMA. Activities conducted November 1 through April 30 will need to

comply with the seasonal mandatory speed restriction period for this SMA for any work or transit within this area.

Throughout all phases of the survey activities, Empire Wind will monitor NOAA Fisheries North Atlantic right whale reporting systems for the establishment of a DMA. If NOAA Fisheries should establish a DMA in the Lease Area or cable route corridor being surveyed, within 24 hours of the establishment of the DMA Empire Wind will work with NOAA Fisheries to determine which actions are necessary, including a potential shut down and/or alteration of activities to avoid the DMA.

Note that mitigation for the HRG surveys will be updated to reflect the current best management practices as agreed to by NOAA Fisheries at the time the surveys are conducted. The measures outlined here are current as per the 2021 programmatic ESA section 7 consultation regarding offshore wind geophysical and geotechnical surveys (BOEM and NOAA Fisheries 2021).

7.4.1 Pre-clearance, Ramp-up, and Shutdown Protocols

7.4.1.1 Pre-clearance Procedures

For all HRG survey activities that operate below 180 kHz that have been determined by NOAA Fisheries as likely to result in harassment of marine mammals, Empire Wind will implement a 30-minute clearance period of the Pre-clearance zones prior to the initiation of ramp-up. During this period the Pre-clearance zones will be monitored by the PSO using the appropriate visual technology for a 30-minute period. Ramp-up may not be initiated if any marine mammal is observed within its respective Pre-clearance zone. If a marine mammal is observed within a Pre-clearance zone during the pre-start clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). Any large whale sighted by a PSO within 500 m of the HRG source that cannot be identified to species must be treated as if it were a North Atlantic right whale.

7.4.1.2 Ramp-up Procedures

Where technically feasible, a ramp-up procedure will be used for HRG survey equipment that operates below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals, and that is capable of adjusting energy levels at the start or re-start of HRG survey activities. A ramp-up procedure will be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey area by allowing them to vacate the area prior to the commencement of survey equipment use. The ramp-up procedure will not be initiated during periods of inclement conditions if the Pre-clearance zones cannot be adequately monitored by the PSOs using the appropriate visual technology (e.g., reticulated binoculars, night vision equipment) for a 30-minute period. A ramp-up would begin with the power of the smallest acoustic equipment at its lowest practical power output appropriate for the survey. When technically feasible, the power would then be turned up and other acoustic sources added in way such that the source level would increase gradually.

Ramp-up activities will be delayed if a marine mammal(s) enters a relevant Pre-clearance zone (**Table 6**). Ramp-up will continue if the animal has been observed exiting the Pre-clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species).

7.4.1.3 Shutdown Procedures

The Pre-clearance and Shutdown zones will be maintained, as previously described, by a PSO for the presence of marine mammals or sea turtles before, during, and after HRG survey activities. The following outlines the shutdown procedures:

If a non-delphinid cetacean or sea turtle is sighted within or approaching the established Shutdown zone during operation of HRG equipment operating at or below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals, an immediate shutdown of that survey equipment is required. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown. Subsequent restart of that equipment must use the ramp-up procedures and may only occur following clearance of the Pre-clearance zones of all non-delphinid cetaceans and sea turtles for at least 30 minutes, and all delphinid cetaceans and pinnipeds for at least 15 minutes.

If a seal or a delphinid(s) from the genera *Delphinus*, *Lagenorhynchus*, *Stenella*, or *Tursiops*, is visually detected approaching the survey vessel (e.g., to bow ride) or towed HRG survey equipment, shutdown is not required. If there is uncertainty regarding identification of a marine mammal species (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), PSOs must use best professional judgment in making the decision as to whether to call for a shutdown.

Following a shutdown for any reason, startup of the equipment may begin immediately (i.e., without pre-start clearance) only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the shutdown zone(s) continued throughout the shutdown, (c) the animal(s) prompting the shutdown was visually followed and confirmed by PSOs to be outside of the shutdown zone(s) and heading away from the vessel, and (d) the shutdown zone(s) remains clear of all marine mammals. If these conditions (a, b, c, and d) are not met, the Pre-clearance zones must be monitored for 30 minutes of pre-start clearance observation before HRG equipment (operating <180 kHz) may be turned back on.

If the HRG equipment operating below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals shuts down for reasons other than encroachment into the relevant Shutdown zones by a non-delphinid cetacean, including but not limited to a mechanical or electronic failure, resulting in the cessation of the source for a period greater than 20 minutes, a restart for the HRG survey equipment is required using the full ramp-up procedures and pre-start clearance of the Pre-clearance zones of all cetaceans and pinnipeds for 30 minutes. If the pause is less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the Pre-clearance zones remained clear of cetaceans and pinnipeds. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart for the HRG survey equipment is required using the full ramp-up procedures and pre-start clearance of the Pre-clearance zones for all cetaceans and pinniped for 30 minutes.

8. ADAPTIVE MANAGEMENT

8.1 Sound Field Verification

Sound field measurements will be conducted during the driving of at least two monopiles and at least one jacket pile over the course of construction. Empire Wind proposes that sound field measurements will be conducted during pile driving of the first monopile installed over the course of the Project to compare field measurements with modeled isopleth distances. If pile driving occurs across different seasons, sound field measurements will also be conducted during pile driving of a monopile in a season that differs from the season of the first monopile installation for comparison purposes (i.e., if the first monopile is driven in spring and pile driving also occurs

in fall, sound field measurements will occur on a pile driven in the fall). In addition, if a foundation location is selected that is anticipated to be difficult-to-drive, sound field measurements will occur on the first difficult-to-drive pile location. If difficult-to-drive foundations are driven across different seasons (i.e., summer and winter), sound field measurements will also be conducted during installation of a difficult-to-drive monopile in a season that differs from the season of the first difficult-to-drive monopile installation for comparison purposes. Empire Wind will provide initial results of the sound field measurements to NOAA Fisheries as soon as they are processed.

Sound field measurements will be conducted at distances of approximately 750 m, 2,500 m, and 5,000 m from the pile being driven, as well as at the extent of the modeled Level B harassment zones to verify the accuracy of those modeled zones. The recordings will be continuous throughout the duration of all impact hammering of each pile monitored. The measurement systems will have a sensitivity appropriate for the expected sound levels from pile driving received at the nominal ranges throughout the installation of the pile. The frequency range of the system will cover the range of at least 20 Hz to 20 kHz. The system will be designed to have omnidirectional sensitivity and will be designed so that the predicted broadband received level of all impact pile-driving strikes exceed the system noise floor by at least 10 dB. The dynamic range of the system will be sufficient such that at each location, pile driving signals are not clipped and are not masked by noise floor.

A Sound Field Verification Plan will be submitted to NOAA Fisheries for review and approval at least 90 days prior to planned start of pile driving. This plan will describe how Empire Wind will ensure that the location selected is representative of the rest of the piles of that type to be installed and how the effectiveness of the sound attenuation methodology will be evaluated based on the results. Empire Wind will provide the initial results of the field measurements to NOAA Fisheries as soon as they are available.

8.2 Zone Size Refinement

As harassment zone sizes are based on predictive modeling, actual zone sizes may differ from those modeled. To ensure mitigation and monitoring measures, including pre-clearance and shutdown zones, are based on actual zone sizes, Empire Wind proposes that measured *in situ* data collected during the earliest phases of Project construction be used to inform adaptive management.

Empire Wind will provide the initial results of the Sound Field Verification measurements to NOAA Fisheries in an interim report after each monopile installation as soon as they are available, but no later than 72 hours after each installation. If initial Sound Field Verification measurements indicate distances to the isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the distances predicted by modeling (assuming 10 dB attenuation) Empire Wind may request a modification of the pre-clearance and shutdown zones for impact pile driving based on Sound Field Verification results. Empire Wind will have conducted SFV on at least two piles to verify that measured zone sizes are consistently smaller than modeling predictions, before submitting a modification request to be considered by NOAA Fisheries. If Sound Field Verification results indicate measured zone sizes are consistently larger than modeling predictions a plan outlining a combination of enhanced PAM and visual observation will be developed and implemented to address the need for extended pre-clearance and shutdown zones.

8.3 Innovative and Emerging Detection Technology

Technological advances in enhanced marine mammal detection continue to evolve rapidly. IR imaging is the enhanced detection method most studied with reported detection ranges varying depending on the technology and the type of marine mammal. The greatest reported range at sea is 5-8 km for a large whale detection by the AIMMMS- Rheinmetall system (Verfuss et al. 2018; Zitterbart et al. 2020). Automated detection systems used

in conjunction with IR have been developed by several companies and continue to advance with demonstrated improvements in performance. It is anticipated that detection algorithms will continue to improve as the technology continues to advance, facilitated by the need for such technology by the offshore wind industry. It is likely that IR would be used in conjunction with other detection methods including but not limited to PSOs and PAM, as the most effective detection rates have been achieved through a combination of PSOs, PAM and IR imaging (Smith et al. 2020). Detection rates have been shown to significantly increase when IR imaging is used in conjunction with experienced PSOs during daytime conditions and combined with PAM coverage in nighttime or low-visibility conditions (Smith et al. 2020).

Research on marine mammal detection with IR systems and other enhanced marine mammal detection technologies is ongoing, with results expected prior to Project construction. Empire Wind seeks to provide ample opportunity for implementation of these technological advances, as well incorporation of learnings from offshore wind projects that will begin construction prior to Empire Wind, to ensure the most effective mitigation and monitoring measures are deployed during the project. Empire Wind would provide a proposal to implement enhanced detection technologies—including a summary of the enhanced detection technologies, data supporting effectiveness, and an implementation plan—to NOAA Fisheries at least 120 days before proposed implementation.

The adaptive management approach described above will be linked to reporting of measured data and ongoing consultation with NOAA Fisheries on emerging technologies.

9. REPORTING

Empire Wind will provide the following reporting as necessary during construction and survey activities:

- a. Empire Wind will contact NOAA Fisheries within 24 hours of the commencement of pile driving activities and again within 24 hours of the completion of the activity;
- b. If a North Atlantic right whale is observed at any time by PSOs or personnel on any project vessels, during any project-related activity or during vessel transit, sighting information will be reported immediately to the NOAA Fisheries North Atlantic Right Whale Sighting Advisory System: (866) 755-6622.
- c. If a North Atlantic right whale is detected via PAM, a report of the detection will be submitted to the NOAA Fisheries North Atlantic right whale Passive Acoustic Reporting System.
- d. Any observed significant behavioral reactions (e.g., animals departing the area) or injury or mortality to any marine mammals will be reported to NOAA Fisheries within 24 hours of observation.
- e. Any observed dead or injured marine mammal will be reported to NOAA Fisheries Northeast Region Stranding Hotline (800-900-3622) within 24 hours of the sighting, regardless of whether the injury is caused by a project-related vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, Empire Wind will ensure that NOAA Fisheries is notified of the strike immediately. If Empire Wind is responsible for the injury or death, the vessel will assist with any salvage effort as requested by NOAA Fisheries.
- f. Within 90 days after completion of the pile driving activities (vibratory and impact) for that year, a technical report will be provided to NOAA Fisheries that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during pile driving activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

All PSO and PAM operators will use a standardized data entry format for reporting. Final reports will follow a standardized format for PSO reporting regarding activities requiring marine mammal mitigation and

monitoring. An annual report will be provided to NOAA Fisheries and to BOEM summarizing the prior year's activities.

10. REFERENCES

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