DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 217

[Docket No. 221020–0223]

RIN 0648–BL36

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to the Ocean Wind 1 Wind Energy Facility Offshore of New Jersey

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; proposed incidental take regulations; proposed Letter of Authorization; request for comments.

SUMMARY: NMFS has received a request for Incidental Take Regulation (ITR) and associated Letter of Authorization (LOA) from Ocean Wind, LLC (Ocean Wind), a subsidiary of Orsted Wind Power North America, LLC's (Orsted) and a joint venture partner of the Public Service Enterprise Group Renewable Generation, LLC (PSEG), for the incidental take of small numbers of marine mammals during the construction of an offshore wind energy facility (Ocean Wind 1) in a designated lease area on the Outer Continental Shelf (OCS–A–0498) offshore of New Jersey. The requested ITR would govern the authorization of take, by both Level A and Level B harassment, of small numbers of marine mammals over a 5-year period incidental to construction-related pile driving activities (impact and vibratory), potential unexploded ordnances or munitions and explosives of concern (UXOs/MECs) detonation, and high-resolution geophysical (HRG) site characterization surveys conducted by Ocean Wind in Federal and State waters off of New Jersey for the Ocean Wind 1 offshore wind energy facility. A final ITR would allow for the issuance of a LOA to Ocean Wind for a 5-year period. As required by the Marine Mammal Protection Act (MMPA), NMFS requests comments on its proposed rule. NMFS will consider public comments prior to making any final decision on the promulgation of the requested ITR and issuance of the LOA; agency responses to public comments will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than November 25, 2022.

ADDRESSES: Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov* and enter NOAA–NMFS–2022–0109 in the Search box. Click on the ''Comment'' icon, complete the required fields, and enter or attach your comments.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible. NMFS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Kelsey Potlock, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of Ocean Wind's Incidental Take Authorization (ITA) application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable.* In case of problems accessing these documents, please call the contact listed above (see **FOR FURTHER INFORMATION CONTACT**).

Purpose and Need for Regulatory Action

This proposed rule would establish a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) to allow for the authorization of take of marine mammals incidental to the construction activities within the mid-Atlantic (New Jersey) region of the U.S. East Coast, specifically in and around lease area OCS–A–0498. We received a petition from Orsted's subsidiary, Ocean Wind requesting the 5-year regulations to construct the Ocean Wind 1 offshore wind energy facility. During the construction of Ocean Wind 1, some activities may cause the harassment (''take'') of marine mammals. Take would occur by Level A and/or Level B harassment incidental to construction activities. Please see the *Legal Authority for the Proposed Action* section below for definitions of harassment.

Legal Authority for the Proposed Action

The MMPA prohibits the ''take'' of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made, regulations are promulgated, and notice is provided to the public.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other ''means of effecting the least practicable adverse impact'' on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, the availability of the species or stocks for taking for certain subsistence uses (referred to as ''mitigation''), and requirements pertaining to the mitigation, monitoring and reporting of the takings are set forth. The definitions of all applicable MMPA statutory terms cited above are included below.

Section 101(a)(5)(A) of the MMPA and the implementing regulations at 50 CFR part 216, subpart I provide the legal basis for proposing and, if appropriate, issuing this rule containing 5-year regulations and associated LOA. As directed by this legal authority, this proposed rule contains mitigation, monitoring, and reporting requirements.

Summary of Major Provisions Within the Proposed Rule

The following is a summary of the major provisions found within this proposed rule regarding Ocean Wind's construction activities. These measures include:

- Establishing a seasonal moratorium on impact pile driving during the months of highest North Atlantic right whale (*Eubalaena glacialis*) presence in the project area (January 1–April 30);
- Establishing a seasonal moratorium on any unexploded ordnances or munitions and explosives of concern (UXOs/MECs) detonations, that are determined to be necessary, during the months of highest North Atlantic right whale present in the project area (January 1–April 30);

• Requiring UXO/MEC detonations to only occur during hours of daylight and not during hours of darkness or nighttime;

• Conducting both visual and passive acoustic monitoring by trained, NOAA Fisheries-approved Protected Species Observers (PSOs) and Passive Acoustic Monitoring (PAM) operators before, during, and after the in-water construction activities;

• Establishing harassment zones that correspond to underwater noise levels that could cause injury and behavioral disturbances;

• Establishing clearance and shut down zones for all in-water construction activities to prevent or reduce Level A harassment and minimize Level B harassment;

• Requiring the use of sound attenuation device(s) during all impact pile driving and UXO/MEC detonations to reduce noise levels;

• Delaying the start of pile driving if a North Atlantic right whale is observed at any distance by the PSO on the pile driving or dedicated PSO vessels;

• Delaying the start of pile driving if other marine mammals are observed entering or within their respective clearance zones;

• Shutting down pile driving (if feasible) if a North Atlantic right whale is observed or if other marine mammals enter their respective shut down zones;

• Implementing soft starts for impact pile driving and using the least hammer energy possible;

• Implementing ramp-up for high-resolution geophysical (HRG) site characterization survey equipment;

• Requiring PSOs to continue to monitor for 30 minutes after any impact pile driving occur and for any and all UXO detonations;

• Increasing awareness of North Atlantic right whale presence through monitoring of the appropriate networks and Channel 16, as well as reporting any sightings to the sighting network;

• Implementing numerous vessel strike avoidance measures;

• A requirement to implement noise attenuation system(s) during all impact pile driving and UXO/MEC detonations;

• Sound field verification requirements during impact pile driving and UXO/MEC detonation to measure in situ noise levels for comparison against the model results; and

• Removing gear from the water during fisheries monitoring research surveys if marine mammals are considered at-risk or are interacting with gear.

National Environmental Policy Act (NEPA)

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must evaluate the proposed action (*i.e.,* promulgation of regulations and subsequent issuance of a 5-year LOA) and alternatives with respect to potential impacts on the human environment.

Accordingly, NMFS proposes to adopt the Bureau of Ocean Energy Management's (BOEM) Environmental Impact Statement (EIS), provided our independent evaluation of the document finds that it includes adequate information analyzing the effects of authoring the proposed take of marine mammals on the human environment. NMFS is a cooperating agency on BOEM's EIS. BOEM's draft EIS (Ocean Wind 1 Draft Environmental Impact Statement (DEIS) for Commercial Wind Lease OCS–A 0498) was made available for public comment on June 24, 2022 at *https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1.* The DEIS had a 45-day public comment period (87 FR 37883, June 24, 2022), plus a 15-day extension (87 FR 48038, August 5, 2022) for a total of 60-days; the comment period was open from June 24, 2022 to August 23, 2022. Additionally, BOEM held three virtual public hearings on July 14, 2022, July 20, 2022, and July 26, 2022.

Information contained within Ocean Wind's ITA application and this **Federal Register** document collectively provide the environmental information related to these proposed regulations and associated 5-year LOA for public review and comment. NMFS will review all comments submitted in response to this document prior to concluding our NEPA process or making a final decision on the requested 5-year LOA.

Fixing America's Surface Transportation Act (FAST–41)

This project is covered under Title 41 of the Fixing America's Surface Transportation Act, or ''FAST–41.'' FAST–41 includes a suite of provisions designed to expedite the environmental review for covered infrastructure projects, including enhanced interagency coordination as well as milestone tracking on the public-facing Permitting Dashboard. FAST–41 also places a 2-year limitations period on any judicial claim that challenges the validity of a Federal agency decision to issue or deny an authorization for a FAST–41 covered project (42 U.S.C. 4370m–6(a)(1)(A)).

Ocean Wind's proposed project is listed on the Permitting Dashboard (*https://www.permits.performance.gov/*). Milestones and schedules related to the environmental review and permitting associated with the Ocean Wind 1 project can be found at *https://www.permits.performance.gov/permitting-projects/ocean-wind-project.*

Summary of Request

On October 1, 2021, NMFS received a request from Ocean Wind for the promulgation of a 5-year ITR and issuance of an associated LOA to take marine mammals incidental to the construction activities associated with the Ocean Wind 1 Offshore Wind Energy Facility off of New Jersey in the BOEM Lease Area Outer Continental Shelf (OCS)–A–0498 Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf.

Ocean Wind's request is for the incidental, but not intentional, take of a small number of 17 marine mammal species (comprising 18 stocks) by Level B harassment (for all 18 marine mammal species and stocks) and by Level A harassment (for 10 marine mammal species or stock). Neither Ocean Wind nor NMFS expects serious injury or mortality to result from the specified activities.

We received subsequent applications and supplementary materials on November 12, 2021, December 3, 2021, December 28, 2021, January 5, 2022, January 20, 2022, and February 8, 2022 in response to questions and comments submitted about various aspects of the previously received iterations. The final version of the application was deemed adequate and complete on February 11, 2022 and is available on NMFS' website at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility.*

A Notice of Receipt (NOR) for the application was published on March 7, 2022 in the **Federal Register** (87 FR 12666) for a 30-day public comment period. This public comment period closed on April 6, 2022. During the NOR public comment period, NMFS received two letters from environmental non-governmental organizations (ENGOs): Clean Ocean Action (COA) and the Natural Resource Defense Council (NRDC), on behalf of several other ENGOs. NMFS has reviewed all submitted material and has taken these into consideration during the drafting of this proposed rulemaking.

NMFS has previously issued three Incidental Harassment Authorizations (IHAs), including a renewed IHA, to

Ocean Wind for related work regarding high resolution site characterization surveys (see 82 FR 31562, July 7, 2017; 86 FR 26465, May 14, 2021; and 87 FR 29289, May 13, 2022 (renewal)). To date, Ocean Wind has complied with all the requirements (*e.g.,* mitigation, monitoring, and reporting) of the previous IHAs and information regarding their monitoring results may be found in the Estimated Take section. These monitoring reports can be found on NMFS' website: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable*.

On August 1, 2022, NMFS announced proposed changes to the existing North Atlantic right whale vessel speed regulations to further reduce the likelihood of mortalities and serious injuries to endangered right whales from vessel collisions, which are a leading cause of the species' decline and a primary factor in an ongoing Unusual Mortality Event (87 FR 46921). Should a final vessel speed rule be issued and become effective during the effective period of this ITR (or any other MMPA incidental take authorization), the authorization holder would be required to comply with any and all applicable requirements contained within the final rule. Specifically, where measures in any final vessel speed rule are more protective or restrictive than those in this or any other MMPA authorization, authorization holders would be required to comply with the requirements of the rule. Alternatively, where measures in this or any other MMPA authorization are more restrictive or protective than those in any final vessel speed rule, the measures in the MMPA authorization would remain in place. The responsibility to comply with the applicable requirements of any vessel speed rule would become effective immediately upon the effective date of any final vessel speed rule and, when notice is published of the effective date, NMFS would also notify Ocean Wind if the measures in the speed rule were to supersede any of the measures in the MMPA authorization such that they were no longer applicable.

Description of the Specified Activities

Overview

Ocean Wind has proposed to construct and operate a 1,100 megawatt (MW) wind energy facility (known as Ocean Wind 1) in State and Federal waters found in the Atlantic Ocean in lease area OCS–A–0498. The Ocean Wind 1 project would allow the State of New Jersey to meet its renewable energy goals under the New Jersey Offshore Wind Economic Development Act (OWEDA). OWEDA was signed into law in August 2010 and required the New Jersey Board of Public Utilities to establish a program to incentivize the development of offshore wind facilities and structures. On January 31, 2018, Governor Phil Murphy signed Executive Order #8 which further directed all New Jersey State Agencies with described responsibilities under OWEDA to work to meet a goal of 3,500 MW of energy from offshore wind by 2030 (*https://nj.gov/infobank/eo/056murphy/pdf/EO-8.pdf*). Then, in November 19, 2019, Executive Order #92 was signed and increased New Jersey's offshore wind goal of 3,500 MW by 2030 to 7,500 MW by 2035 (*https://nj.gov/infobank/eo/056murphy/pdf/EO-92.pdf*). More information on New Jersey's offshore wind goals can be found at: *https://www.nj.gov/dep/offshorewind/about.html*.

Ocean Wind's project would consist of several different types of permanent offshore infrastructure, including wind turbine generators (WTGs; *e.g.,* the GE Haliade-X 12 MW) and associated foundations, offshore substations (OSS), offshore substation array cables, and substation interconnector cables. Overall, Ocean Wind plans to install 98 WTGs and 3 offshore substations (OSS) via impact pile driving; the temporary installation and removal of cofferdams to assist in the installation of the export cable route by vibratory pile driving; several types of fishery and ecological monitoring surveys; the placement of scour protection; trenching, laying, and burial activities associated with the installation of the export cable route from OSSs to shore-based converter stations and inter-array cables between turbines; HRG vessel-based site characterization surveys using active acoustic sources with frequencies of less than 180 kHz; and the potential detonation of up to ten UXOs/MECs of different charge weights, as necessary. Vessels would transit within the project area, and between ports and the wind farm to transport crew, supplies, and materials to support pile installation. All offshore cables will connect to onshore export cables, substations, and grid connections, which would be located in Ocean County and Cape May County found in New Jersey.

Marine mammals exposed to elevated noise levels during impact and vibratory pile driving, potential detonations of UXOs, or site characterization surveys, may be taken, by Level A harassment and/or Level B harassment, depending on the specified activity. At the time of writing this proposed notice, Ocean Wind 1 had not finalized design plans; however, they have indicated the project would consist of either all monopile foundations (a total of 101 8/11-m tapered piles to support all WTGs and the 3 OSSs) or monopiles to support the WTGs (n=98) and jacket foundations with pin piles to support the three OSSs using a total of 48 pin piles (16 pin piles per OSS).

Dates and Duration

Ocean Wind anticipates activities resulting in harassment to marine mammals occurring throughout all five years of the proposed rulemaking. Project activities are expected to begin in August 2023 and continue through July 2028. Ocean Wind anticipates the following construction schedule over the five year period (Figure 1). Ocean Wind has noted that these are the best and conservative estimates for activity durations (solid arrows), but that the schedule may shift due to weather, mechanical, or other related delays (dashed arrows). If promulgated, the proposed rule and subsequently issued 5-year LOA would be effective from 2023–2028.

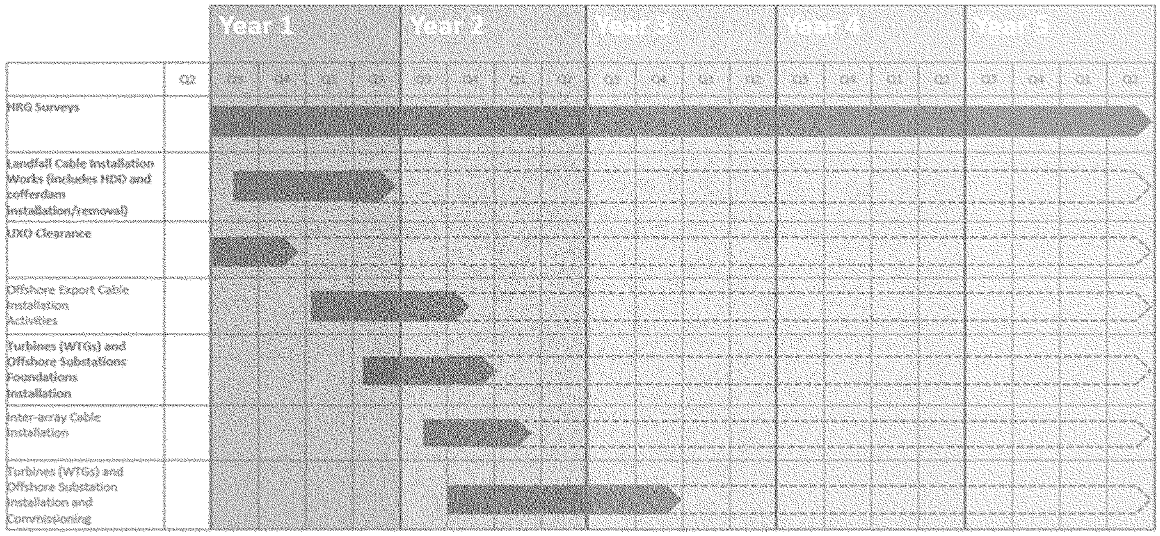

Figure 1 -- Ocean Wind's Proposed Construction Schedule

WTG and OSS Pile Installation (Impact Pile Driving)

The installation of monopiles and pin piles related to the construction of up to 98 tapered 8/11-m diameter WTGs (monopile foundations) and 3 OSSs (either consisting of up to 3 monopile or 3 jacket foundations using 48 pin piles total) would occur from May through December and only in Years 1 and 2, depending on local and environmental conditions.

Ocean Wind's present uncertainty with which construction scenario would be employed for OSS installation has resulted in two possible timelines of either 52 or 116 days of installation for all foundation piles related to WTGs and OSSs (monopiles or pin piles). In the 52-day scenario, the schedule assumes a full monopile build-out with the installation of two monopiles per day for WTGs (49 days total) and one monopile per day for each OSS (3 days total). In the 116-day scenario, the schedule assumes a joint monopile-jacket foundation build-out, with the installation of up to one monopile per day for WTGs (98 days total) and up to three pin piles being installed per day over 6 days per OSS (18 days total). Ocean Wind notes in their application that technical problems, such as pile refusal, are not anticipated but could result in additional pile driving days.

Each monopile is expected to require four hours of impact pile driving to install, with a maximum of two monopiles being installed per day. However, in some cases, only one monopile may be installed on some days. Each pin pile is expected to require four hours of impact pile driving, with a maximum of three pin piles being installed per day.

During the installation of monopile foundations, Ocean Wind has requested 24-hour pile driving, which would consist of intermittent impact pile driving that could occur anytime within a 24-hour timeframe and would occur for a total 8 hours of active pile driving plus 1 hour of equipment mobilization (9 hours total). However, only the maximum estimated number of piles per day (two monopiles) would be installed in any 24-hour period. Furthermore, no concurrent impact pile driving (of either monopiles or pin piles) is anticipated to occur during this proposed project.

Ocean Wind anticipates that the first WTG would become operational in 2024 as each turbine would be powered on after installation is completed and all necessary components, such as array cables, OSSs, export cable routes, and onshore substations are installed.

Temporary Cofferdam Installation and Removal (Vibratory Pile Driving)

The installation and removal of up to seven temporary cofferdams at various transition points for the export cable routes, as needed, would primarily occur between October through March, although Ocean Wind does indicate that some removal of cofferdams may occur during the months of April or May.

Installation of each cofferdam would require a maximum of 12 hours via vibratory driving while removal using a vibratory extractor would require 18 hours. All seven cofferdams would necessitate 2 days for installation and 2 days for removal (4 days total) with only 12 hours of vibratory removal occurring per day. This equates to a total of 28 days for all installation and removal. NMFS notes that these 28 days may not be consecutive but would be the total number expected during the entire construction period.

High-Resolution Geophysical Site Characterization Surveys

High-resolution geophysical site characterization surveys would occur annually, with durations dependent on the activities occurring in that year (*i.e.,* construction year versus a non-construction year). Specifically, Ocean Wind estimates a maximum of 88 days of surveys to occur annually in Years 1, 4, and 5 (the pre- and post-construction years); and 180 days annually during Years 2 and 3 (the during-construction years). This estimates approximately 624 days total over the 5-year period. More specifically, in Years 1, 4, and 5, up to 47.5 survey days are expected in the offshore Wind Farm area and 40.5 survey days would occur in the export cable route areas. During Years 2 and 3, up to 180 days are planned with variable survey effort expected, but Ocean Wind anticipates approximately 78 days annually would take place within the export cable route areas and 102 days of survey effort during both of these years would occur in the offshore Wind Farm area. These HRG survey schedules, as proposed by Ocean Wind, do account for periods of down-time due to inclement weather or technical malfunctions.

Ocean Wind anticipates site characterization surveys occurring in the project area and along the two potential export cable routes to the landfall locations (Oyster Creek, Island Beach State Park in Barnegat Bay, Farm Property, and BL England) specified in the ITA application (see Figure 1–3 in the ITA application; Ocean Wind, 2022b). HRG surveys would utilize up to three vessels working concurrently across the project area over a 24-hour period. Up to three vessels would also perform nearshore surveys; however, these vessels would operate for 12-hours and during daylight only. At any time, all three of the 24-hour vessels may work across different parts of the project area or within the same geographic area. In calculating the HRG vessel effort for the purposes of estimating marine mammal take, it was determined that each day that any given survey vessel is operating would count as a single survey day. For example, if all three vessels are operating in the two export cable routes and Lease Area concurrently, this would count as 3 survey days, regardless of the locations that are being surveyed.

Unexploded Ordnances or Munitions and Explosives of Concern (UXOs/MECs)

Ocean Wind anticipates the potential presence of UXOs/MECs in and around the project area during the 5 years of the proposed rule. These UXOs/MECs are defined as explosive munitions (*e.g.,* shells, mines, bombs, torpedoes, *etc.*) that did not explode or detonate when they were originally deployed or that were intentionally discarded to avoid detonations on land. Typically, these munitions could be left behind following Navy military training, testing, or operations. Ocean Wind primarily plans for avoidance or relocation of any UXOs/MECs found within the project area, when possible. In some cases, it may also be possible that the UXO/MEC could be cut up to extract the explosive components. However, Ocean Wind notes this may not be possible in all cases and in situ disposal may be required. If in situ disposal is required, all disposals will be performed using low-order methods (deflagration), which are considered less impactful to marine mammals, first and then would be elevated up to high-order removal (detonation), if this approach is determined to be necessary. In the event that high-order removal is needed, all detonations would only occur during daylight hours.

Based on preliminary survey data, Ocean Wind conservatively estimates a maximum of 10 days of UXO/MEC detonation may occur, with up to one UXO/MEC being detonated per day and a maximum of 10 UXOs/MECs being detonated over the entire 5-year period. NMFS notes that UXOs/MECs may be detonated at any point in any year as they are found by project developers; however, no UXOs/MECs would be detonated in Federal waters between November 1st and April 30th of any year during the rulemaking.

Specific Geographic Region

Ocean Wind's specified activities would occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem (NES LME), an area of approximately 260,000 km^2 (64,247,399.2 acres) from Cape Hatteras in the south to the Gulf of Maine in the north. Specifically, the lease area and cable corridor are located within the Mid-Atlantic Bight subarea of the NE LME which extends between Cape Hatteras, North Carolina, and Martha's Vineyard, Massachusetts, extending westward into the Atlantic to the 100 m isobath. In the Middle Atlantic Bight, the pattern of sediment distribution is relatively simple. The continental shelf south of New England is broad and flat, dominated by fine grained sediments. Most of the surficial sediments on the continental shelf are sands and gravels. Silts and clays predominate at and beyond the shelf edge, with most of the slope being 70–100 percent mud. Fine sediments are also common in the shelf valleys leading to the submarine canyons. There are some larger materials, left by retreating glaciers, along the coast of Long Island and to the north and east.

Primary productivity is highest in the nearshore and estuarine regions, with coastal phytoplankton blooms initiating in the winter and summer, although the timing and spatial extent of blooms varies from year to year. The relatively productive continental shelf supports a wide variety of fauna and flora.

Ocean Wind 1's proposed activities would occur in the Ocean Wind Lease Area OCS–A 0498 (see Figure 2 in this proposed rule and see Figures 1–1 in the ITA application for more detail; Ocean Wind, 2022b), within the New Jersey WEA of BOEM's Mid-Atlantic Planning Area. Ocean Wind's 277 square kilometer (km^2; 68,450 acres) Wind Farm Area is found within the larger 306 km^2 (75,525 acre) New Jersey Wind Energy Area (WEA). The Ocean Wind Wind Farm Area (WFA) is located approximately 13 nautical miles (nm; 24.08 km) southeast of Atlantic City, New Jersey. Noise from the specified activities will extend into the surrounding areas and is included in the specified geographic region. For consistency throughout this proposed rulemaking, NMFS will be referring to the Wind Farm Area and export cable corridors where development of the Ocean Wind 1 offshore wind facility would occur as the ''project area''. At its nearest point, Ocean Wind 1 would be just over 13 nm (15 miles (mi)) southeast of Atlantic City, New Jersey. The water depths range from 15–36 meters (m; 49–118 feet (ft)) in the Offshore Wind Farm Area and approximately 40 m (131.23 ft) in the export cable route areas. The seabed has a slope of less than 1 degree towards the southeast. The sedimentation in the area is predominantly sandy with some thin clay layers. Ocean Wind has noted that the average temperature of the water column (the upper 10–15 m) is higher in June to September, which increases the sound speeds and creates a downward refracting environment that propagates sounds more directly to the seafloor. However, from December to March, an increase in wind mixing and a reduction in solar energy creates a sound speed profile that is more uniform with depth.

As part of the construction activities, up to seven temporary cofferdams may be constructed where the two potential export cable routes exit the seabed. The onshore landing locations for Ocean Wind 1's export cable routes would be Oyster Creek, Island Beach State Park Barnegat Bay, Farm Property, and BL England, with grid connections being made in BL England and Oyster Creek (Figure 2). Up to 98 wind turbines would be constructed alongside three offshore-substations (OSSs). Inter-array cables would connect all WTGs to OSSs with the export cables connecting the wind facility to the cofferdam locations nearshore (see Figure 3 in this proposed ITA and see Figures 1–2 in the rulemaking application for more detail).

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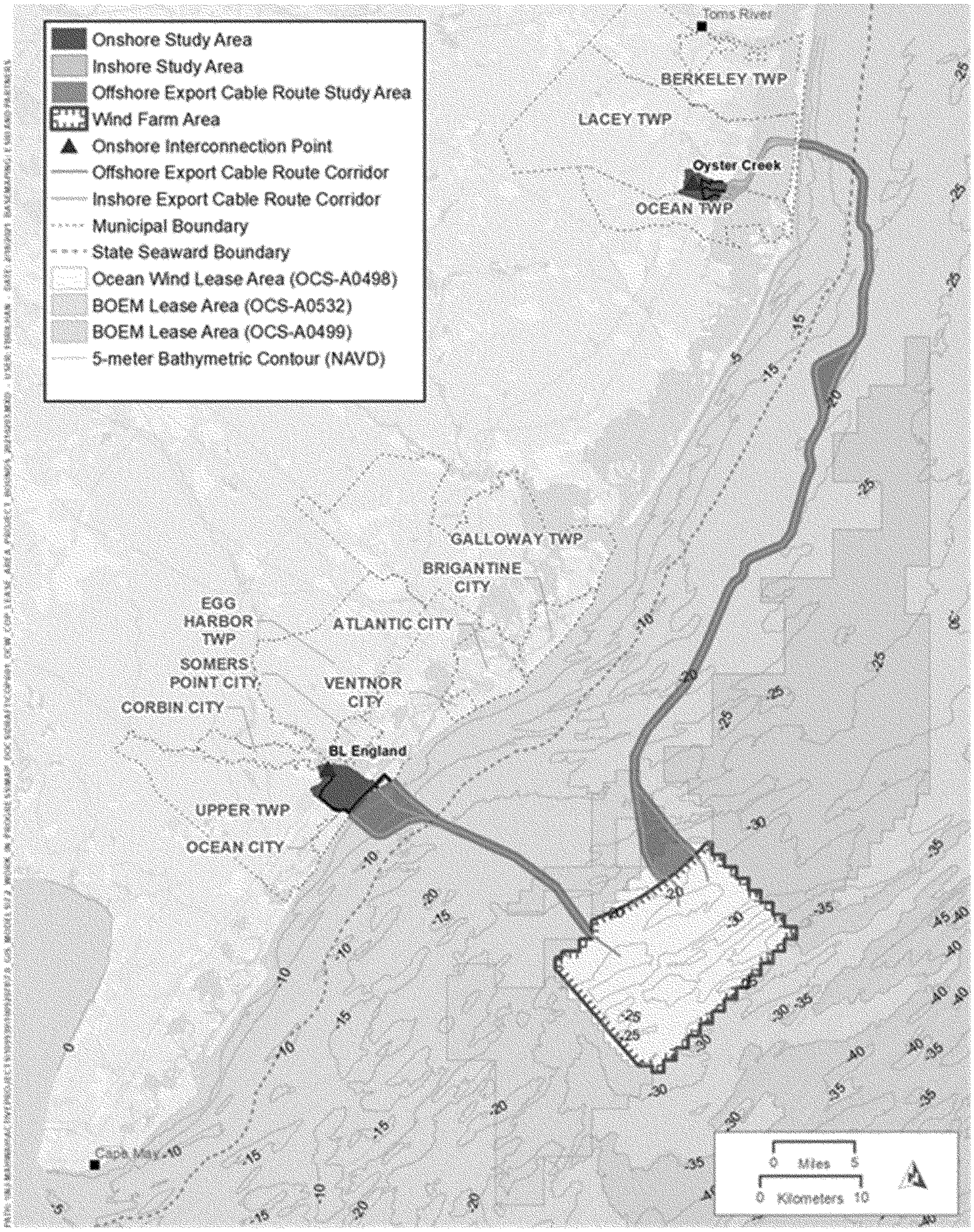

Figure 2 -- Location of Lease Area OCS-A 0498, Ocean Wind 1 Offshore Wind Farm (Ocean Wind 1) and Two Potential Export Cable Routes

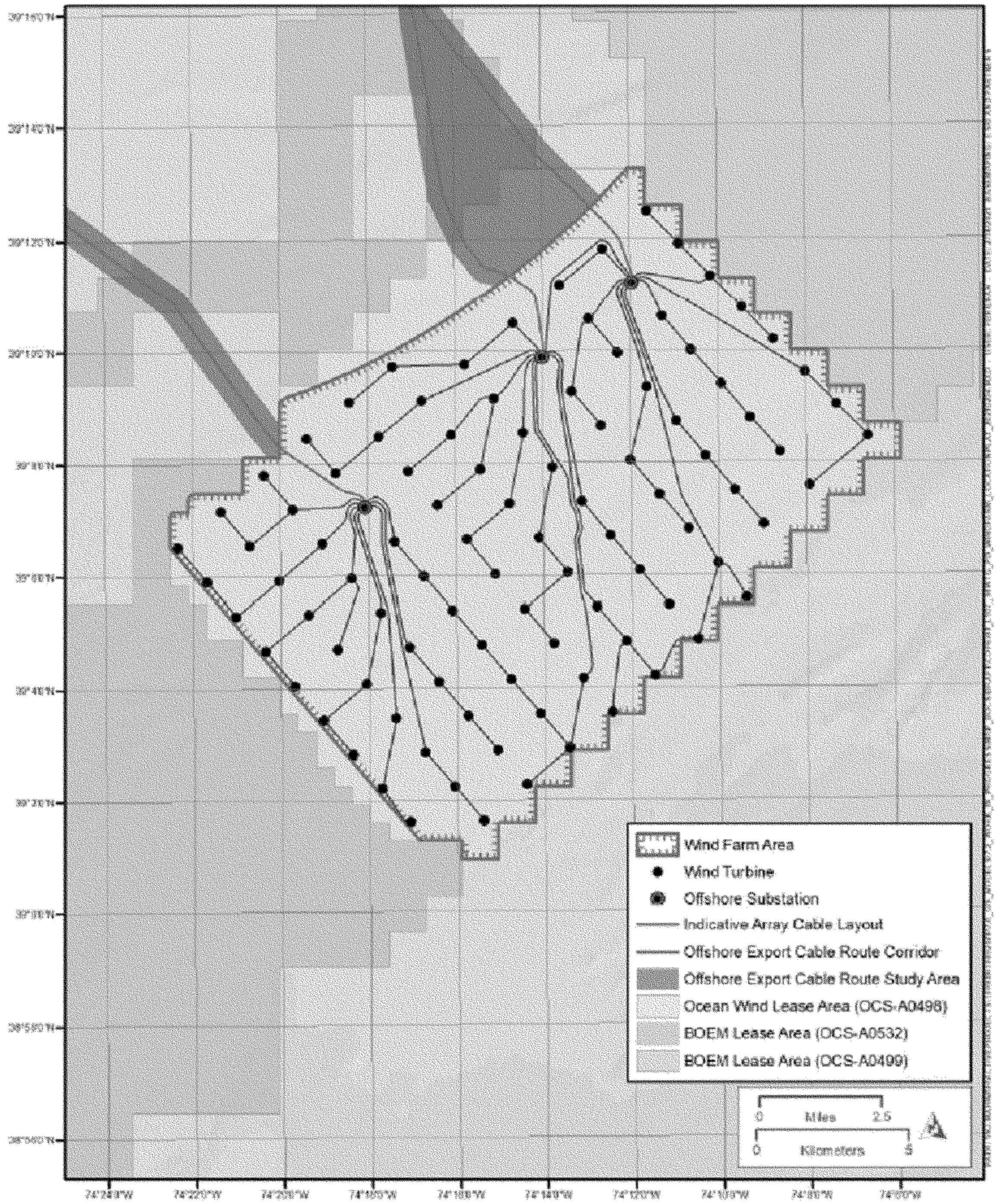

Figure 3 -- The Potential Layout of the Wind Farm Area Including the Wind Turbine Generators (WTGs), Offshore Substations (OSS) and Inter-Array Cables

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Detailed Description of Specified Activities

Below, we provide detailed descriptions of Ocean Wind's activities, explicitly noting those that are anticipated to result in the take of marine mammals and for which incidental take authorization is requested. Additionally, a brief explanation is provided for those activities that are not expected to result in the take of marine mammals.

Impact Pile Driving—WTGs

Impact pile driving, which is expected to result in the take of marine mammals, is planned for both WTGs (monopiles) and OSS installation (monopiles or pin piles) and will be used to support the installation of both permanent and temporary structures.

Ocean Wind plans to use a monopile with transition piece (or alternatively a one-piece foundation where the transition piece is part of the monopile) design for all of the WTG locations. This reflects the planned type of foundation based on the preliminary site data obtained for the Project and was selected as it is the most economical solution, the simplest and quickest to install, and requires the least seabed disturbance. Pile driving is only planned to occur from May through December (Years 1 and 2) to reduce North Atlantic right whale interactions, further discussion of this may be found in the Proposed Mitigation section. The monopile will be 11-meters (m; 36-ft) in diameter at the seafloor with a 6-m (20-ft) diameter flange, and will taper to a top diameter of 8 m. Since drafting the Ocean Wind COP (Vol. I, Table 6.1.1–3; Ocean Wind, 2021), project development has continued and for design development of the monopile foundations, a monopile foundation with maximum outer diameter at seabed of 11-m (36-ft) is being carried forward.

The monopile foundations will be installed by one or two heavy lift or jack-up vessels. The main installation vessel(s) will likely remain at the Offshore Wind Farm during the installation phase and transport vessels, tugs, and/or feeder barges will provide a continuous supply of foundations to the Offshore Wind Farm. If appropriate vessels are available, the foundation components could be picked up directly in the marshaling port by the main installation vessel(s).

Each vertical monopile foundation will consist of a single hollow steel cylinder pile, up to 11-m (36-ft) in diameter with a 10.3-centimeter (4-inch) wall thickness. As mentioned above, the monopiles are tapered piles with 8-m top diameter, 11-m bottom diameter, and a tapered section near the water line (referred to as an 8/11 monopile throughout this proposed notice). The installation of all 98 WTGs would only utilize tapered monopile foundations with one monopile being used per WTG.

The monopiles will be installed using an impact hammer, an IHC–4000 or IHC S2500 kilojoule (kJ) hammer, or similar, with a power pack capacity of 6,000 kilowatts (kW), to a maximum expected penetration depth of 50-m (164-ft). Up to two monopiles will be installed per day (estimated at 4 hours of active pile driving per monopile) for an estimated total of 8 hours per day (assuming active pile driving of two monopiles). A total of 98 monopiles will be installed for WTGs. Three additional monopiles may be installed as foundations for the OSSs. Concurrent monopile installation at more than one location is not planned by Ocean Wind and was not analyzed in the ITA application.

Pile installation would occur during daylight hours and could, if Ocean Wind meets NMFS requirements (see Proposed Mitigation section), potentially occur during nighttime hours when, (1) a pile installation is started during daylight and, due to unforeseen circumstances, would need to be finished after dark and (2) for new piles, after dark initiation of pile driving is necessary to meet schedule requirements due to unforeseen delays. To be able to install WTG and OSS monopile foundations, impact pile driving 24-hours per day is deemed necessary when considering the amount of time required to install the foundations in comparison to the time available for installation when factoring in various limitations. Based on similar projects under ideal conditions and consistent with the assumption that up to two foundations could be installed in a single day, installation of a single pile at a minimum would involve a 1-hour pre-clearance period, 4 hours of piling, and 4 hours to move to the next piling location where the process would begin again. This results in an estimated 9 hours of installation time per monopile for the Ocean Wind project, or 909 total hours for 98 WTG foundations and three OSS foundations, assuming ideal conditions for all installations. Once construction begins, Ocean Wind would proceed as rapidly as possible to reduce the total duration of construction, limiting crew transfers and vessel trips by condensing the work as much as possible. Particularly in low North Atlantic right whale abundance months, completing more work in the summer means less overlap with higher density time periods.

Impact Pile Driving—OSSs

A piled jacket foundation, being considered for the OSSs only, is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seabed by hollow steel pin piles attached to the jacket feet. Unlike monopiles, there is no separate transition piece. The transition piece and ancillary components are fabricated as an integrated part of the jacket. Each OSS will have either a single 8/11-m diameter monopile foundation (as used for WTG foundations) or a jacket foundation consisting of 16 2.44-m diameter vertical pin piles installed with an impact hammer, IHC S–2500 kJ hammer, or similar. Each of the piled jacket foundations will consist of four pin piles per leg (16 pin piles total) per OSS. Up to three vertical pin piles will be installed each day during construction of the OSSs, and it is expected to take 4 hours per piling. Six days of installation per OSS foundation is anticipated. The pin piles will be driven to a maximum expected depth of 70 m (230 ft). A total of 48 pin piles (16 pin piles × 3 OSSs) or three monopiles could be installed for the OSSs.

Vibratory Pile Driving—Temporary Cofferdams

The in-water use of vibratory pile driving is expected to result in the take of marine mammals. Unlike impact pile driving, vibratory pile driving is planned to exclusively occur during the potential installation and removal of temporary cofferdams. A temporary cofferdam may need to be installed seaward of the horizontal directional drilling (HDD) landfall locations where the export cable exits from the seabed. The cofferdam, if required, may be installed as either a sheet-piled structure into the seafloor or a gravity cell structure placed on the seafloor using ballast weight. A vibratory hammer will be used to drive sheet pile sidewalls and end walls into the seabed. Installation of a cofferdam is estimated to take up to 18 hours over 2 days, with vibratory driving taking place for no longer than 12 hours each day over the installation period. Removal of the cofferdam will be accomplished using a vibratory extractor and is expected to take up to 18 hours over 2 days, with no more than 12 hours of vibratory removal each day. Cofferdam installation/removal will take place only during daylight hours.

Cofferdams are planned at the following sites: two cofferdams at Oyster Creek (Atlantic Ocean to Island Beach State Parks a sea-to-shore connection point), two cofferdams at Island Beach State Park Barnegat Bay (Barnegat Bay onshore as a bay-to-shore connection point), two cofferdams at Farm Property (bayside of Oyster Creek as a shore-to-bay connection point), and one cofferdam at BL England (as a sea-to-shore connection point). Cofferdams will necessitate minimal water to be temporarily pumped out for construction activities, and then subsequently re-flooded upon the completion of activities. Dewatering activities will be temporary and water drawdown will be minimal to prevent any permanent impacts to groundwater quality.

Ocean Wind considered two scenarios for the cofferdams: a sheet pile installation and removal scenario and a gravity-cell structure ballasted to the seafloor. In moving forward with the sheet pile scenario, Ocean Wind anticipates that impacts relating to cofferdam installation and removal using sheet piles would exceed any potential impacts for the use of alternative methods (*i.e.,* gravity-cells), and therefore the cofferdam estimates using the sheet pile approach ensures that the most conservative values are carried forward in this proposed action.

In addition to the sound produced in-water from the vibratory driving activities, it is possible that in-air noises from the vibratory hammer could be produced during temporary cofferdam installation and removal. In-air noise is not considered a concern for cetaceans and in-water pinniped species, but could pose a risk to hauled-out seals in the area, specifically harbor seals. However, based on the analysis conducted in Section 1.5.4 of Ocean Wind's ITA application (Figure 1–8), neither Ocean Wind nor NMFS expect the in-air sounds produced to cause take of hauled-out pinnipeds at distances greater than 541 m from the cofferdam installation/removal location (Ocean Wind, 2022b). As all documented pinniped haul-outs are located further than 541 m from each of the seven cofferdam locations, no take of marine mammals is expected from any in-air noise component of vibratory pile driving. Furthermore, any additional discussion relating to vibratory pile driving of temporary cofferdams will refer to in-water noise effects, unless otherwise noted.

High-Resolution Site Characterization Surveys

Ocean Wind plans to conduct HRG surveys operating at frequencies less than 180 kHz in and around the Offshore Wind Farm and along potential export cable routes to landfall locations in New Jersey throughout construction and operation. Survey activities, which include the potential to result in the take of marine mammals, will include multibeam depth sounding, seafloor imaging, and shallow- and medium-penetration sub-bottom profiling within the Offshore Wind Farm and export cable route area, using non-parametric equipment, including boomers, sparkers, and Compressed High-Intensity Radiated Pulse (CHIRPs).

While the final survey plans will not be completed until construction contracting commences, Ocean Wind anticipates that HRG survey operations would be conducted 24 hours per day and up to three vessels may be working concurrently within this 24-hour period at a transit speed of approximately 4 knots. Based on Ocean Wind's past survey experience (*i.e.,* knowledge of typical daily downtime due to weather, system malfunctions, *etc.*), Ocean Wind assumes 70 km average daily distance. On this basis, an annual total of 88 survey days (approximately 47.5 survey days in the Offshore Wind Farm and 40.5 survey days in the export cable route area) is expected during Years 1, 4, and 5. Some inter-year variance in survey locations may be expected, however, 88 survey days annually is anticipated regardless of location. During Years 2 and 3, Ocean wind anticipates up to 78 days annually of survey effort within the export cable route areas and up to 102 days of survey effort during both Years 2 and 3 to occur in the Wind Farm Area.

Ocean Wind estimates that a total of 6,110 linear kilometers (km) will be needed within the Offshore Wind Farm and export cable route area. Survey effort will be split between the two areas: 3,000 km for the array cable, 2,300 km for the Oyster Creek export cable, 510 km for the BL England export cable, and 300 km for the OSS interconnector cable. During WTG and OSS construction and operation, it is anticipated that up to 180 survey days per year will be required, which includes up to 11,000 km of export cable surveys, 10,500 km of array cable surveys, 1,065 km of foundation surveys, 250 km of WTG surveys, and up to 2,450 km of monitoring and verification surveys. In certain shallow-water areas, vessels may conduct surveys during daylight hours only, with a corresponding assumption that the daily survey distance would be halved (35 km). Although, for purposes of analysis, a single vessel survey day is assumed to cover the maximum 70 km.

The following acoustic sources planned for use during Ocean Wind's HRG survey activities that have the potential to result in incidental take of marine mammals:

- Shallow-penetration non-impulsive, non-Parametric SBPs (compressed high-intensity radiated pulses (CHIRP SBPs)) are used to map the near-surface stratigraphy (top 0 to 5 m (0 to 16 ft)) of sediment below the seabed. A CHIRP system emits sonar pulses that increase in frequency sweep from approximately 2 to 20 kHz over time. The pulse length frequency range can be adjusted to meet Project variables. These shallow penetration SPBs are typically mounted on a pole, rather than towed, either over the side of the vessel or through a moon pool in the bottom of the hull, reducing the likelihood that an animal would be exposed to the signal.
- Medium-penetration impulsive boomers are used to map deeper subsurface stratigraphy as needed. A boomer is a broad-band sound source operating in the 3.5 Hz to 10 kHz frequency range. This system is commonly mounted on a sled and towed behind the vessel.
- Medium-penetration impulsive sparkers are used to map deeper subsurface stratigraphy as needed. Sparkers create acoustic pulses from 50 Hz to 4 kHz omnidirectionally from the source that can penetrate several hundred meters into the seafloor. Sparkers are typically towed behind the vessel with adjacent hydrophone arrays to receive the return signals.

Table 1 identifies all the representative survey equipment that operate below 180 kilohertz (kHz) (*i.e.,* at frequencies that are audible and have the potential to disturb marine mammals) that may be used in support of planned geophysical survey activities, and are likely to be detected by marine mammals given the source level, frequency, and beamwidth of the equipment. Equipment with operating frequencies above 180 kHz (*e.g.,* SSS, MBES) and equipment that does not have an acoustic output (*e.g.,* magnetometers) will also be used but are not discussed further because they are outside the general hearing range of marine mammals likely to occur in the project area. No harassment exposures can be reasonably expected from the operation of these sources; therefore, they are not considered further in this proposed action.

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Table 1 -- Ocean Wind's Representative HRG Equipment

Representative HRG Equipment	Operating Frequency	SLrms (dB re 1 μPa m)	SL0-pk (dB re 1 μPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	CF = Crocker and Fratantonio (2016) MAN = manufacturer
Non-parametric shallow penetration SPBs (non-impulsive)							
ET 216 (2000DS or 3200 top unit)	2-16 2-8	195	-	20	6	24	MAN
ET 424	4-24	176	-	3.4	2	71	CF
ET 512	0.7-12	179	-	9	8	80	CF
GeoPulse 5430A	2-17	196	-	50	10	55	MAN
Teledyne Benthos Chirp III - TTV 170	7-2	197	-	60	15	100	MAN
Medium penetration SBPs (impulsive)							
AA, Dura-spark (400 tips, 500J)[a]	0.3-1.2	203	211	1.1	4	Omni	CF
AA, triple plate S-Boom (700-1,000J)[b]	0.1-5	205	211	0.6	4	80	CF

- = not applicable; ET = EdgeTech; J = joule; kHz = kilohertz; dB = decibels; SL = source level; UHD = ultra-high definition; AA = Applied Acoustics; rms = root-mean square; μPa = microPascals; re = referenced to; SPL = sound pressure level; PK = zero-to-peak pressure level; Omni = omnidirectional source.

a - The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the survey. These include variants of the Dura-spark sparker system and various configurations of the GeoMarine Geo-Source sparker system. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available.

b - Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP–D700 and CSP–N). The CSP–D700 power source was used in the 700 J measurements but not in the 1,000 J measurements. The CSP–N source was measured for both 700 J and 1,000 J operations but resulted in a lower SL; therefore, the single maximum SL value was used for both operational levels of the S-Boom.

Potential UXO/MEC Detonations

There is the potential that Ocean Wind could encounter UXOs/MECs. These include explosive munitions such as bombs, shells, mines, torpedoes, *etc.* that did not explode when they were originally deployed or were intentionally discarded to avoid land-based detonations. There are several varieties of ordnance and net explosive weights can vary according to type. All bombs are inert but simulate the same ballistic properties.

The risk of incidental detonation associated with conducting seabed-altering activities such as cable laying and foundation installation in proximity to UXOs/MECs jeopardizes the health and safety of project participants. Ocean Wind follows an industry standard As Low as Reasonably Practicable (ALARP) process that minimizes the number of potential detonations (Appendix C; Ocean Wind, 2021).

While avoidance is the preferred approach for UXO/MEC mitigation, there may be instances when confirmed UXO/MEC avoidance is not possible due to layout restrictions, presence of archaeological resources, or other factors that preclude micro-siting. In such situations, confirmed UXO/MEC may be removed through physical relocation or in situ disposal, the latter of which may result in the take of marine mammals. Physical relocation will be the preferred method but is not an option in every case. Selection of a removal method will depend on the location, size, and condition of the confirmed UXO/MEC, and will be made in consultation with a UXO/MEC specialist and in coordination with the agencies with regulatory oversight of UXO/MECs. For UXO/MECs that will require in situ disposal, it will be done with low-order methods (deflagration), high-order (detonation) of the UXO/MEC, or by cutting the UXO/MEC up to extract the explosive components.

To better assess the potential UXO/MEC encounter risk, geophysical surveys have been and continue to be conducted to identify potential UXOs/MECs that have not been previously mapped. As these surveys and analysis of data from them are still underway, the exact number and type of UXOs/MECs in the project area are not yet known. As a conservative approach for the purposes of the impact analysis, it is currently assumed that up to 10 UXOs/MECs 454-kg (1000 pounds; lbs) charges, which is the largest charge that is reasonably expected to be present, may have to be detonated in place. Although it is highly unlikely that all ten charges would consist of this 454 kg charge, as the Navy uses many different sizes of smaller charges (even down to a few kilograms), it was determined to be the most conservative during analysis when analyzing the potential effects of the activity. If necessary, these detonations would occur on up to 10 different days (*i.e.,* only one detonation would occur per day) over the 5-year project. In the event that high-order removal (detonation) is determined to be the preferred and safest method of disposal, all detonations would occur during daylight hours. It is expected that impacts from detonation would occur within the current limits defined for the Project Offshore Envelope, but are dependent on the soil conditions, burial depth, and type of UXO/MEC found.

Construction-Related Vessel Activities and Transit

During construction of the project, Ocean Wind anticipates that an average of approximately 18 project-related vessels will operate during a typical workday in the Wind Farm Area and along the export cable routes. As multiple vessels may be operating concurrently, each day that a survey vessel is operating counts as a single survey day. For example, if a total of three vessels are operating with one in each of the two ECRs (two total) and one in the Lease Area (one total) concurrently, this counts as three survey days. Many of these vessels will remain in the Wind Farm Area or export cable route for days or weeks at a time, potentially making only infrequent trips to port for bunkering and provisioning, as needed. The actual number of vessels involved in the project at one time is highly dependent on the project's final schedule, the final design of the project's components, and the logistics needed to ensure compliance with the Jones Act, a Federal law that regulates maritime commerce in the United States. Table 2 below shows the number of vessels and the number of vessel trips anticipated during construction activities related to Ocean Wind 1.

Table 2 -- Type and Number of Vessels, and Number of Vessel Trips, Anticipated during Construction Activities over the Effective Period of the Requested ITA

Vessel Types	Max Number of Simultaneous Vessels	Max Number of Return Trips Per Vessel Type
Wind Turbine Foundation Installation		
Scour Protection Vessel	1	50
Installation Vessels	4	99
Support Vessels	16	396
Transport/Feeder Vessels (Including Tugs)	40	396
Anchored Transport/Feeder Vessels (including tugs)	2	198
Structure Installation		
Installation Vessels	2	99
Transport/Feeder Vessels	12	99
Other Support Vessels	24	594
Helicopters[1]	2	75
Main Laying Vessels	3	99
Main Burial Vessels	3	99
Support Vessels	12	594
Duration Per Cable Section In Days	-	3.5
Total Duration In Months	-	12
Substation Installation		
Primary Installation Vessels	2	12
Support Vessels	12	72
Transport Vessels	4	24

Maximum Duration (Days)	67	-
Substation Interconnection Cable Installation		
Main Laying Vessels	Included In Numbers For Export And Array Cables	8
Main Burial Vessels		8
Support Vessels		12
Duration: Per Cable In Days		20
Duration: Total In Months		1
Offshore Export Cable Installation		
Main Cable Laying Vessels	3	48
Main Cable Jointing Vessels	3	36
Main Cable Burial Vessels	3	48
Support Vessels	15	
Duration Per Cable Section In Days	-	59
Typical Duration In Months	-	6

1 - Although helicopters were included in the ITA application, at the time of writing this proposed action, Ocean Wind has informed NMFS that no helicopter use is planned to occur during this proposed action and any mentions of helicopter use will be removed from Ocean Wind's COP.

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While marine mammals are known to respond to vessel noise and the presence of vessels in different ways, we do not expect Ocean Wind 1's vessel operations to result in the take of marine mammals. As existing vessel traffic in the vicinity of the project area off of New Jersey is relatively high, we expect that marine mammals in the area are likely somewhat habituated to vessel noise. In addition, any construction vessels would be stationary for significant periods of time when on-site and any large vessels would travel to and from the site at relatively low speeds. Project-related vessels would be required to adhere to several mitigation measures designed to reduce the potential for marine mammals to be struck by vessels associated with the project; these measures are described further below (see the Proposed Mitigation section) and vessel strikes are neither anticipated nor authorized. As part of various construction related activities, including cable laying and construction material delivery, dynamic positioning thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of dynamic positioning thrusters is similar to that produced by transiting vessels, in that dynamic positioning thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. Sound produced by dynamic positioning thrusters would be preceded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence, further reducing the potential for startle or flight responses on the part of marine mammals. Accordingly, noise from construction-related vessel activity, including the use of dynamic positioning thrusters, is not expected to result in take of marine mammals and Ocean Wind did not request, and NMFS does not propose to authorize any takes associated with construction related vessel activity. However, NMFS acknowledges the aggregate impacts of Ocean Wind 1's vessel operations on the acoustic habitat of marine mammals and has considered it in the analysis.

Fisheries Monitoring Surveys

Ocean Wind plans to undertake various fisheries monitoring surveys in collaboration with several academic partners throughout the period of effectiveness for this rule. As described in Section 1.3.4 of the ITA application, Ocean Wind has developed a Fisheries Monitoring Plan (FMP) in consultation with BOEM's ''Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf'' (BOEM, 2019). Ocean Wind plans to conduct various types of surveys, including surveys using gear similar to that used in commercial fisheries (*e.g.,* trawl nets, hook and line gear, gillnets, pot/trap), acoustic telemetry surveys, environmental DNA (eDNA) sampling, clam surveys, oceanographic glider surveys, and pelagic fish surveys (Ocean

Wind, 2022b). The Plan also includes structured habitat surveys involving use of chevron traps and a pelagic and benthic baited remote underwater video (BRUV) device connected to the surface by vertical lines.

Gear and activities that NMFS does not expect to have the potential to cause impacts to marine mammals include: use of autonomous gliders, clam surveys using a slow moving hydraulic dredge, non-extractive surveys specifically for pelagic fish (through use of baited and towed camera traps and autonomous glider equipment with echosounders), and non-extractive eDNA collection from water samples taken while in the field, and acoustic telemetry surveys of pelagic fish. These activities, or use of these gear types, are unlikely to have any potential to impact marine mammals as the gear types do not involve use of components that marine mammals are likely to interact with (*e.g.,* become entangled in, be hooked by) or the surveys involve passive interaction with the environment.

Planned fishery survey activities including use of gear that could have potential to result in marine mammal interaction (*e.g.,* trawl surveys, hook and line activities, gillnet use, pot/trap deployment, and chevron trap and BRUV use) are required to implement Best Management Practices (BMPs) that would minimize this risk to the point that take is not reasonably anticipated to occur. Because of the BMPs stated in the Proposed Mitigation section, neither NMFS nor Ocean Wind anticipates any incidental take of marine mammals to occur from the fisheries-specific activities described herein and in the ITA application (Ocean Wind, 2022b). Accordingly, Ocean Wind has not requested any take of marine mammals incidental to these fisheries surveys, nor does NMFS propose to authorize any given the nature of the activities and, for certain gear types, the mitigation measures planned for use by Ocean Wind. Therefore, fishery monitoring survey activities are not analyzed further in this document.

Dredging Activities

Dredging typically consists of the removal and sometimes transportation of underwater sediment to deepen a specific area. This is typically performed in navigational channels for vessel traffic. The ITA application notes that dredging may be required prior to cable laying in the event sandwaves are present and that dredging may need to occur across the lifetime of the project (Ocean Wind, 2022b).

NMFS does not expect dredging to generate noise levels that would cause take of marine mammals. Most of the energy falls below 1 kHz, which indicates that it is highly unlikely to cause damage to marine mammal hearing (Todd *et al.,* 2015). For example, a study by Reine and Clarke (2014) found that, using a propagation loss coefficient of 15LogR, source levels of dredging operations in the shallow waters (less than 15 m depth) in New York Harbor were measured at and did not exceed 151 dB *re 1 μPa,* which is not expected to cause hearing shifts in marine mammals. A more recent analysis by McQueen *et al.* (2020) found that, using a maximum sound level of 192 dB *re 1 μPa,* the resulting isopleths for representative marine mammals (*i.e.,* the harbor seal and the harbor porpoise), the resulting isopleths for temporary shifts in hearing would occur less than 20 m and less than 74 m, respectively. Isopleths for permanent shifts were noted as less than 1 m for both marine mammal species.

In Section 3.15 (Marine Mammals) of the Ocean Wind 1 draft EIS (*https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1*), BOEM states that ''Based on the available source level information presented in Section 3.15.5, dredging by mechanical or hydraulic dredges is unlikely to exceed marine mammal permanent threshold shifts (PTS; injury) thresholds, but if dredging occurs in one area for relatively long periods temporary threshold shifts (TTS) and behavioral thresholds could be exceed as well as masking of marine mammal communications (Todd *et al.,* 2015; NMFS, 2018).'' While NMFS acknowledges the potential of short-duration masking or slight behavioral changes (Todd *et al.,* 2015) to occur during dredging activities, any effects on marine mammals are expected to be short-term, low intensity, and unlikely to qualify as take. Given the size of the area that dredging operations would be occurring in, as well as the coastal nature of some of these activities for the nearshore sea-to-shore connection points related to temporary cofferdam installation/removal, NMFS expects that any marine mammals would not be exposed at levels or durations likely to disrupt normal life activities (*i.e.,* migrating, foraging, calving, etc.). Therefore, the potential for take of marine mammals to result from these activities is so low as to be discountable and Ocean Wind did not request, and NMFS does not propose to authorize, any takes associated with dredging and dredging activities are not analyzed further in this document.

Cable Laying and Installation

Cable burial operations will occur both in Ocean Wind 1 Wind Farm Area for the inter-array cables connecting the WTGs to the OSS and in the Ocean Wind 1 export cable route for the cables carrying power from the OSS to land. Inter-array cables will connect the 98 WTGs to the OSS. A single offshore export cable will connect the OSSs to the New Jersey sea-to-shore transition point. The offshore export and inter-array cables will be buried in the seabed at a target depth of 1.2 to 2.8 m (4 to 6 ft). All cable burial operations will follow installation of the monopile foundations, as the foundations must be in place to provide connection points for the export cable and inter-array cables.

All cables will be buried below the seabed, when possible, and buried onshore up to the transition joint bays. The targeted burial depths will be determined later by Ocean Wind, following a detailed design and Cable Burial Risk Assessment. This Assessment will note where burial cannot occur, where sufficient depths cannot be achieved, and/or where additional protection is required due to the export cable crossing other cables or pipelines (either related to the Ocean Wind 1 project or not). Burial of cables will be performed by specific vessels, which are described in Tables 6.1.2–5, 6.1.2–6, 6.1.2–7, 6.1.2–8, and 6.1.2–9 in the Ocean Wind 1 COP (*https://www.boem.gov/ocean-wind-1-construction-and-operations-plan*).

Cable laying, cable installation, and cable burial activities planned to occur during the construction of Ocean Wind 1 may include the following:

- Jetting;
- Vertical injection;
- Leveling;
- Mechanical cutting;
- Plowing (with or without jet-assistance);
- Pre-trenching; and,
- Controlled flow excavation.

Ocean Wind notes that installation days are not continuous and do not include equipment preparation or downtime that may result from weather or maintenance.

Some dredging may be required prior to cable laying due to the presence of sandwaves. Sandwave clearance may be undertaken where cable exposure is predicted over the lifetime of the Project due to seabed mobility. Alternatively, sandwave clearance may be undertaken where slopes become greater than approximately 10 degrees (17.6 percent), which could cause instability to the burial tool. The work could be undertaken by traditional dredging methods such as a trailing suction hopper. Alternatively, controlled flow excavation or a sandwave removal plough could be used. In some cases, multiple passes may be required. The method of sandwave clearance Ocean Wind chooses will be based on the results from the site investigation surveys and cable design. More information on cable laying associated with the proposed project is provided in Ocean Wind's COP (Ocean Wind, 2022a) and NMFS further references the reader to the Ocean Wind 1 COP found on BOEM's website (*https://www.boem.gov/ocean-wind-1-construction-and-operations-plan*). As the noise levels generated from this activity are low, the potential for take of marine mammals to result is discountable (86 FR 8490, February 5, 2021) and Ocean Wind does not request marine mammal take associated with cable laying. Therefore, cable laying activities are not analyzed further in this document.

Offshore Wind Farm Operational Noise

Although this proposed rulemaking primarily covers the noise produced from construction activities relevant to the Ocean Wind 1 offshore wind facility, operational noise was a consideration in NMFS' analysis of the project, as all 98 turbines would become operational within the effective dates of the rule, beginning no sooner than 2024. It is expected that a minimum of 68 turbines would be operational in 2024 with the rest installed and operational in either late 2024 or 2025. Once operational, offshore wind turbines are known to produce continuous, non-impulsive underwater noise, primarily in the lower-frequency bands (below 8 kHz).

In both newer, quieter, direct-drive systems (such as what has been proposed for Ocean Wind 1) and older generation, geared turbine designs, recent scientific studies indicate that operational noise from turbines is on the order of 110 to 125 dB *re 1 μPa,* root-mean-square sound pressure level (SPL_{rms}) at an approximate distance of 50 m (Tougaard *et al.,* 2020). Tougaard *et al.* (2020) further noted that sound levels could reach as high as 128 dB *re 1 μPa,* SPL_{rms} in the 10 Hz to 8 kHz range. However, BOEM notes that the Tougaard *et al.* (2020) study assumed that the largest monopile-specific WTG was 3.6 MW, which is much smaller than those being considered for the Ocean Wind 1 project (Ocean Wind 1 DEIS, Section 3.13 Finfish, Invertebrates, and Essential Fish Habitat; BOEM, 2022). Tougaard further stated that the operational noise produced from WTGs is static in nature and is lower than noise produced from passing ships. This is a level that marine mammals in this region are likely already habituated to. Furthermore, operational noise levels are likely lower than those ambient levels already present in active shipping lanes, meaning that any operational noise levels would likely only be detected at a very close proximity to the WTG (Thomsen *et al.,* 2006; Tougaard *et al.,* 2020). Furthermore, the noise from operational wind turbines has been previously found to be much lower in intensity than the noises present during construction, although this was based on a single turbine with a maximum power of 2 MW (Madsen *et al.,* 2006). Other studies by Jansen and de Jong (2016) and Tougaard *et al.* (2009b) determined that while marine mammals would be able to detect operational noise from offshore wind farms (older 2 MW models) for several thousand kilometers, the effects produced from this should have no significant impacts on the individual survival, population viability, marine mammal distribution, or the behavior of the animals. However, these studies are, again, based on older models and not newer generation turbines with more modernized and quieter technology.

More recently, a study by Stöber and Thomsen (2021) was published where the authors were looking to estimate the operational noise from the larger, more recent generation of direct-drive WTGs. Their findings demonstrated that more modern turbine designs could generate higher operational noise levels (170 to 177 dB *re 1 μPa* SPL_{rms} for a 10 MW WTG) than those previously reported for older models. These results are similar to the results presented by Tougaard *et al.* (2020). However, the results of this study haven't been validated yet as they were based on a small sample size (Ocean Wind 1 DEIS, section 3.15 Marine Mammals; BOEM, 2022).

Specifically related to the proposed Ocean Wind 1 project, BOEM included operational noise throughout the DEIS. As described in Ocean Wind 1's DEIS (in COP Volume II, Appendix R–2; BOEM, 2022), BOEM states that the operational noises would primarily consist of low-frequency sounds (60 to 300 Hz) and consist of relatively low SPLs. It further concludes that, ''It is unlikely that WTG operations will cause injury or behavioral responses to marine fauna [including marine mammals], so the risk of impact is expected to be low.'' While exceptions have been previously noted in the scientific literature where some lower-frequency sounds produced by some marine mammal species (*i.e.,* odontocete burst-pulsed sounds (Richardson *et al.,* 1995) and bottlenose dolphin bray-calls (Janik, 2000)), may fall within similar ranges of operational wind turbine noise, these assumptions were previously attributed based upon the older generation turbines not using the more recent and modern drive shafts. Furthermore, based on the modern type of turbine planned for use in Ocean Wind 1, BOEM has preliminarily determined that no physiological effects on fish would result from WTG operation, which would indicate that no marine mammal prey impacts are likely to occur (Ocean Wind 1 DEIS, Section 3.13 Finfish, Invertebrates, and Essential Fish Habitat; BOEM, 2022). Furthermore, as many offshore permanent structures, including offshore wind farms, are known to attract fish species and other invertebrates after construction in an artificial reef effect (Wilson and Elliott, 2009; Lindeboom *et al.,* 2011; Langhamer, 2012; Glarou *et al.,* 2020), BOEM and Ocean Wind consider adverse impacts to marine mammal prey are unlikely. Neither BOEM nor Ocean Wind currently expect take of marine mammals to result from WTG operation, and Ocean Wind did not request take authorization from this activity. NMFS acknowledges that more research on the impacts of operational noise on marine mammals and their prey is needed, as currently available information on modern turbine models is limited. However, based on the information above, including the small numbers of turbines and short duration of operation that would be covered under this rule, NMFS is preliminarily not proposing to authorize take of marine mammals from operational noise from WTGs and it is not discussed or analyzed further in this proposed **Federal Register** notice.

In consideration of all activities in which the proposed harassment and subsequent take of marine mammals is considered a possibility, NMFS further addresses conservative approaches for the proposed mitigation, monitoring, and reporting measures, which are described in detail later in this document (see Proposed Mitigation and Proposed Monitoring and Reporting sections).

Description of Marine Mammals in the Area of Specified Activities

Several marine mammal species occur within the project area. Sections 3 and 4 of Ocean Wind's ITA application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species (Ocean Wind, 2022b). Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SARs; *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.,* physical and behavioral descriptions) may be found on NMFS' website (*https://www.fisheries.noaa.gov/find-species*).

Table 3 lists all species or stocks for which take is expected and proposed to be authorized for this action, and summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) and potential biological removal (PBR), where known. PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS' SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Atlantic and Gulf of Mexico SARs. All values presented in Table 3 are the most recent available data at the time of publication which can be found in NMFS' SARs (Hayes *et al.,* 2022), available online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports*.

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Table 3 -- Marine Mammal Species[1] Likely To Occur Near the Project Area That May be Taken by Ocean Wind's Activities

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N)[2]	Stock abundance (CV, N_{min}, most recent abundance survey)[3]	PBR	Annual M/SI[4]
Order Artiodactyla – Infraorder Cetacea – Mysticeti (baleen whales)						
Family Balaenidae						
North Atlantic right whale	*Eubalaena glacialis*	Western Atlantic	E, D, Y	368 (0; 364; 2019)[5]	0.7	7.7
Family Balaenopteridae (rorquals)						
Blue whale	*Balaenoptera musculus*	Western North Atlantic	E, D, Y	UNK (UNK; 402; 1980-2008)	0.8	0
Fin whale	*Balaenoptera physalus*	Western North Atlantic	E, D, Y	6,802 (0.24; 5,573; 2016)	11	1.8
Sei whale	*Balaenoptera borealis*	Nova Scotia	E, D, Y	6,292 (1.02; 3,098; 2016)	6.2	0.8

Minke whale	*Balaenoptera acutorostrata*	Canadian Eastern Coastal	-, -, N	21,968 (0.31; 17,002; 2016)	170	10.6
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	-, -, Y	1,396 (0; 1,380; 2016)	22	12.15
Odontoceti (toothed whales, dolphins, and porpoises)						
Family Physeteridae						
Sperm whale	*Physeter macrocephalus*	North Atlantic	E, D, Y	4,349 (0.28; 3,451; 2016)	3.9	0
Family Delphinidae						
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	-, -, N	93,233 (0.71; 54,433; 2016)	544	27
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	-, -, N	39,921 (0.27; 32,032; 2016)	320	0
Common bottlenose dolphin	*Tursiops truncatus*	Northern Migratory Coastal	-, -, Y	6,639 (0.41; 4,759; 2016)	48	12.2-21.5
		Western North Atlantic Offshore	-, -, N	62,851 (0.23; 51,914; 2016)	519	28
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	-, -, Y	28,924 (0.24; 23,637; 2016)	236	136
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	-, -, N	39,215 (0.30; 30,627; 2016)	306	9
Risso's dolphin	*Grampus griseus*	Western North Atlantic	-, -, N	35,215 (0.19;	301	34

				30,051; 2016)		
Common dolphin	*Delphinus delphis*	Western North Atlantic	-, -, N	172,974 (0.21; 145,216; 2016)	1,452	390
Family Phocoenidae (porpoises)						
Harbor porpoise	*Phocoena*	Gulf of Maine/Bay of Fundy	-, -, N	95,543 (0.31; 74,034; 2016)	851	16
Order Carnivora – Pinnipedia						
Family Phocidae (earless seals)						
Gray seal[6]	*Halichoerus grypus*	Western North Atlantic	-, -, N	27,300 (0.22; 22,785; 2016)	1,458	4,453
Harbor seal	*Phoca vitulina*	Western North Atlantic	-, -, N	61,336 (0.08; 57,637; 2018)	1,729	339

1 – Information on the classification of marine mammal species can be found on the web page for The Society for Marine Mammalogy's Committee on Taxonomy (https://marinemammalscience.org/science-and-publications/list-marine-mammal-species-subspecies/; Committee on Taxonomy (2022)).
2 – ESA status: Endangered (E), Threatened (T) / MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.
3 – NMFS marine mammal stock assessment reports online at: www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments. CV is the coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable.
4 – These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (e.g., commercial fisheries, ship strike).
5 – The draft 2022 SARs have yet to be released; however, NMFS has updated its species web page to recognize the population estimate for North Atlantic right whales is now below 350 animals (https://www.fisheries.noaa.gov/species/north-atlantic-right-whale).
6 – NMFS' stock abundance estimate (and associated PBR value) applies to the U.S. population only. Total stock abundance (including animals in Canada) is approximately 451,431. The annual M/SI value given is for the total stock.

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All 38 species that could potentially occur in the proposed survey areas are included in Table 3–1 of the Ocean Wind 1 ITA application and discussed therein (Ocean Wind, 2022b). While the majority of these species have been documented or sighted off the New Jersey coast in the past, for the species and stocks not listed in Table 3, NMFS considers it unlikely that their occurrence would overlap the activity in a manner that would result in harassment, either because of their spatial occurrence (*i.e.,* more northern or southern ranges) and/or with the geomorphological characteristics of the underwater environment (*i.e.,* water depth in the development area). Because of this, these species are not discussed further.

In addition, the Florida manatees (*Trichechus manatus;* a sub-species of the West Indian manatee) has been previously documented as an occasional visitor to the Northeast region during summer months (U.S. Fish and Wildlife Service (USFWS), 2019). However, manatees are managed by the USFWS and are not considered further in this document.

As indicated above, all 17 species (with 18 managed stocks) in Table 3 temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur. Five of the marine mammal species for which take is requested have been designated as ESA-listed, including North Atlantic right, blue, fin, sei, and sperm whales. In addition to what is included in Sections 3 and 4 of Ocean Wind's ITA application (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility*), the SARs (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*), and NMFS' website (*https://www.fisheries.noaa.gov/species-directory/marine-mammals*) provide further general information regarding life history, threats, and status of the impacted species and stocks. Below, we provide additional information, where available and applicable, to inform our impact analyses including designated Unusual Mortality Events, or ESA Critical Habitat, or information regarding other known areas of known biological importance.

Two specific areas have been designated as Critical Habitat for North Atlantic right whales. The calving ground is located in the southern Atlantic coast and extends from Georgia to Florida. The foraging ground extends from Maine to Massachusetts and includes the Gulf of Maine and Georges Bank region. With regards to Ocean Wind 1, both of these specific Critical Habitat locations are found several hundreds of miles from the project area and should not be impacted by this proposed project. Furthermore, no Critical Habitat for other species is close enough to be impacted by Ocean Wind's activities.

Under the MMPA, an unusual mortality event (UME) is defined as ''a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response'' (16 U.S.C. 1421h(6)). As of September 2022, seven UMEs are considered active, with five of these occurring along the Atlantic coast for several marine mammal species. Currently the most relevant to this proposed action are the UMEs related to the minke whale, the North Atlantic right whale, and the humpback whale. The Florida manatee UME is not discussed further as manatees are not one of NMFS' trust species. This species is managed by the USFWS and more information can be found on their website (*https://myfwc.com/research/manatee/rescue-mortality-response/ume/*). The recent 2022 Northeast Pinniped UME is not discussed further as impacts of this UME have only been recorded along the southern and central coast of Maine (*https://www.fisheries.noaa.gov/2022-pinniped-unusual-mortality-event-along-maine-coast*). Given that these areas are found several hundreds of miles away from the Ocean Wind 1 project area, and are only presently known to these areas off of Maine, the pinniped UME is not discussed further in this proposed notice. More information on UMEs, including all active, closed, or pending, can be found on NMFS' website at *https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events*.

Below, we include additional information for the subset of species that presently have an active or recently closed UME occurring along the Atlantic coast, or for which there is information available related to areas of specific biological significance. For the majority of species potentially present in the specific geographic region, NMFS has designated only a single generic stock (*e.g.,* ''western North Atlantic'') for management purposes. This includes the ''Canadian east coast'' stock of minke whales, which includes all minke whales found in U.S. waters and is also a generic stock for management purposes. For humpback and sei whales, NMFS defines stocks on the basis of feeding locations, *i.e.,* Gulf of Maine and Nova Scotia, respectively. However, references to humpback whales and sei whales in this document refer to any individuals of the species that are found in the specific geographic region. Any areas of known biological importance (including the Biologically Important Areas (BIAs) identified in Van Parijs *et al.,* 2015) that overlap spatially with the project area are addressed in the species sections below.

North Atlantic Right Whale

The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world and has been listed as a federally endangered species since 1970. The Western Atlantic stock is considered depleted under the MMPA (Hayes *et al.,* 2022). North Atlantic right whales are currently threatened by low population abundance, higher than normal mortality rates and lower than normal reproductive rates. In 2021, Pace *et al.* released an update of a North Atlantic right whale abundance model. From 1990–2014, the female apparent survival rate fluctuated around 0.96. In 2014, survival decreased to approximately 0.93 and hit an all-time low of 0.89 in 2017. However, in 2018, survival increased dramatically back to around 0.95. The average survival rate, based on the Pace *et al.* (2021) regime model from 2014–2018, is approximately 0.93, slightly lower than the average long-term rate from 1990–2014 (0.96). Since 1990, the estimated number of new entrants (which can be used as a proxy for recruitment rates) has widely fluctuated between 0 and 39 (Pace *et al.,* 2021, NMFS 2021). In the last 12 years (2010–2022), the average number of calves born into the population is approximately 13 (as of September 14, 2022).

However, the most recent information on the status of North Atlantic right whales can be found in NMFS' 2022 SAR (Hayes *et al.,* 2022). Although NMFS relies on the most up-to-date SARs, we also acknowledge that the population estimate has been updated to below 350 animals, as reflected on our website (*https://www.fisheries.noaa.gov/species/north-atlantic-right-whale*). We noted that this change in abundance estimate would not change the estimated take or the take NMFS has proposed for authorization of North Atlantic right whales. As a result, this information does not change our ability to make the preliminary required findings under the MMPA for Ocean Wind's proposed construction activities.

The North Atlantic right whale calving season begins around mid-November and ends after mid-April. Female North Atlantic right whales give birth to a single calf after a gestation period of 12 months, and typically repeat this in 3-year intervals. However, per NMFS' website (*https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2022*) and likely due to stress (*e.g.,* entanglements in fishing gear and vessel collisions), North Atlantic right whale mothers have begun having calves every 7 to 10 years, on average (van der Hoop *et al.,* 2017; Pettis *et al.,* 2022) with mean annual calving intervals increasing significantly over the last three decades (Kraus *et al.,* 2020). Further compounding this issue is that not all calves born into the population survive to adulthood or to a viable age for reproduction. For example, on December 22, 2020, a newborn calf was sighted off El Hierro, an island in the Canary Islands, but has not been subsequently detected with its mother, suggesting it did not survive. More recently, a dead North Atlantic right whale calf was reported stranded on February 13, 2021, along the Florida coast. These impacts all further challenge any potential of recovery for the North Atlantic right whale. As previously stated by Greene and Pershing (2004) and Meyer-Gutbrod *et al.* (2021), the effects on changes in calving rates and further effects from climate variability, may continue to make this a vulnerable species and hinder recovery if present trends continue.

As described above, the project area is present in part of an important migratory corridor for North Atlantic right whales, which make annual migrations up and down the Atlantic coast. There is a recovery plan (NOAA Fisheries, 2017) for the North Atlantic right whale, and relatively recently there was a five-year review of the species (NOAA Fisheries, 2017). The North Atlantic right whale only had a 2.8 percent recovery rate between 1990 and 2011 (Hayes *et al.,* 2022). NMFS' website (*https://www.fisheries.noaa.gov/species/north-atlantic-right-whale*) notes fewer than 350 North Atlantic right whales are remaining.

As described above, North Atlantic right whale presence in the project area is seasonal. As a result of several years of aerial surveys and PAM deployments in the area we have confidence that right whales are expected in the project area during certain times of year, while at other times of year right whales are not expected to occur in the project area. LeBreque *et al.* (2015) identify a seasonally active migratory corridor BIA for North Atlantic right whales that overlaps the project area in March–April (northbound route) and November–December southbound. Due to the current status of North Atlantic right whales, and the spatial overlap of the proposed project with an area they are known to seasonally occur in, the potential impacts of the proposed project on right whales warrant particular attention.

Elevated right whale mortalities have occurred since June 7, 2017, along the U.S. and Canadian coast, with the leading category for the cause of death for this UME determined to be ''human interaction,'' specifically from entanglements or vessel strikes. As of early October 2022, there have been 34 confirmed mortalities (dead stranded or floaters; 21 in Canada; 13 in the United States) and 21 seriously injured free-swimming whales for a total of 55 whales. As of October 14, 2022, the UME also considers animals with sublethal injury or illness bringing the total number of whales in the UME to 91. Approximately 42 percent of the population is known to be in reduced health (Hamilton *et al.,* 2021), likely contributing to the smaller body sizes at maturation (Stewart *et al.,* 2022) and making them more susceptible to threats. More information about the North Atlantic right whale UME is available online at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event.*

NMFS' regulations at 50 CFR 224.105 designated nearshore waters of the Mid-Atlantic Bight as Mid-Atlantic U.S. Seasonal Management Areas (SMAs) for North Atlantic right whales in 2008 (73 FR 60173, October 10, 2008). SMAs were developed to reduce the threat of collisions between ships and North Atlantic right whales around their migratory route and calving grounds. While the project area does not overlap with any SMAs, transiting vessels in the Mid-Atlantic Migratory region, specifically out of Delaware Bay (38°52′27.4″ N–075°01′32.1″ W; active between November 1 and April 30) or the New York/New Jersey ports (40°29′42.2″ N–073°55′57.6″ W; active between November 1 and April 30), could travel through these SMAs. NMFS notes that Dynamic Management Areas (DMAs), triggered based on visual sightings documented during the presence of three or more right whales within a specific area, may be established at any time. More information on SMAs and DMAs can be found on NMFS' website at *https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales.*

There are no areas where North Atlantic right whales are specifically known to aggregate for foraging activities that overlap the project area.

Humpback Whale

On September 8, 2016, NMFS divided the once single humpback whale species into 14 distinct population segments (DPS) [1] removed the species-level listing, and in its place listed four DPSs as endangered and one DPS as threatened (81 FR 62260, September 8, 2016). The remaining nine DPSs were not listed. The West Indies DPS, which is not listed under the ESA, is the only DPS of humpback whales that are expected to occur in the Survey Area. Bettridge *et al.* (2015) estimated the size of this population at 12,312 (95 percent Confidence Interval (CI) 8,688–15,954) whales in 2004–05, which is consistent with previous population estimates of approximately 10,000–11,000 whales (Smith *et al.,* 1999; Stevick *et al.,* 2003) and the increasing trend for the West Indies DPS (Bettridge *et al.,* 2015). Whales occurring in the project area are considered to be from the West Indies DPS but are not necessarily from the Gulf of Maine feeding population managed as a stock by NMFS. Given the current data, we expect humpback whales migrating or foraging off the United States East Coast in the North Atlantic Ocean are non-ESA-listed animals (West Indies DPS) that originate from the western North Atlantic Ocean feeding areas (*i.e.,* Gulf of Maine, Gulf of Saint Lawrence, Newfoundland/Labrador, Western Greenland, Iceland, Norwegian Sea, and Northern Norway). Barco *et al.,* 2002 estimated that, based on photo-identification, only 39 percent of individual humpback whales observed along the mid- and south Atlantic U.S. coast are from the Gulf of Maine stock. Bettridge *et al.* (2015) estimated the size of the West Indies DPS is 12,312 (95 percent CI 8,688–15,954) whales in 2004–05, which is consistent with previous population estimates of approximately 10,000–11,000 whales (Stevick *et al.,* 2003; Smith *et al.,* 1999) and the increasing trend for the West Indies DPS (Bettridge *et al.,* 2015). Humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring *et al.,* 2007a; Waring *et al.,* 2007b).

Sighting of humpback whales used to be uncommon off of New Jersey; however, four decades ago, humpback whales were infrequently sighted off the US mid-Atlantic states (USMA, New York, New Jersey, Delaware, Maryland, Virginia and North Carolina; CeTAP, 1982), but they are now common to coastal Virginia in winter when most humpback whales are on their breeding

[1] Under the Endangered Species Act, in 16 U.S.C. 1532(16), a distinct population segment (or DPS) is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. NOAA Fisheries and the US Fish and Wildlife Service released a joint statement on February 7, 1996 (61 FR 4722) that defines the criteria for identifying a population as a DPS.

grounds (Swingle *et al.,* 1993, Barco *et al.,* 2002, Aschettino *et al.,* 2022). This shift is also supported by passive acoustic monitoring data (*e.g.,* Davis *et al.,* 2020). Recently, Brown *et al.* (2022) investigated site fidelity, population composition and demographics of individual whales in the New York Bight apex (which includes New Jersey waters and found that although mean occurrence was low (2.5 days), mean occupancy was 37.6 days, and 31.3 percent of whales returned from one year to the next. The majority of whales were seen during summer (July–September, 62.5 percent), followed by autumn (October–December, 23.5 percent) and spring (April–June, 13.9 percent). They also found sightings of mother-calf pairs were rare. When data were available to evaluate age, most individuals were either confirmed or suspected juveniles, including four whales known to be 2–4 years old based on known birth year, and 13 whales with sighting histories of 2 years or less on primary feeding grounds. Three individuals were considered adults based on North Atlantic sighting records. The young age structure in the nearshore waters of the New York Bight apex is consistent with other literature (Stepanuk *et al.,* 2021; Swingle *et al.,* 1993; Barco *et al.,* 2022). It remains to be determined whether humpback whales in the New York Bight apex represent a northern expansion of individuals that had wintered off Virginia, a southern expansion of individuals from the adjacent Gulf of Maine, or is the result of another phenomenon.

Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine to Florida. Partial or full necropsy examinations have been conducted on approximately half of the 161 known cases (as of October 2022). Of the whales examined, about 50 percent had evidence of human interaction, either ship strike or entanglement. While a portion of the whales have shown evidence of pre-mortem vessel strike, this finding is not consistent across all whales examined and more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. More information regarding this declared UME is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2016-2021-humpback-whale-unusual-mortality-event-along-atlantic-coast*.

A humpback whale feeding BIA extends throughout the Gulf of Maine, Stellwagen Bank, and Great South Channel from May through December, annually (LeBrecque *et al.,* 2015). However, this BIA is located further north and does not overlap with any part of the project area.

Minke Whale

Since January 2017, a UME has been declared based on elevated minke whale mortalities that have occurred along the Atlantic coast from Maine through South Carolina, with a total of 123 strandings (as of October 2022). Full or partial necropsy examinations were conducted on more than 60 percent of the whales. Preliminary necropsy findings show evidence of human interactions or infectious disease, but these findings are not consistent across all of the whales examined, so more research is needed. More information is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-minke-whale-unusual-mortality-event-along-atlantic-coast*.

There are two minke whale feeding BIAs identified in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay and Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge from March through November, annually (LeBrecque *et al.,* 2015). However, these BIAs are located further north and do not overlap with any part of the project area.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 4.

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Table 4 -- Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, Cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al., 2007) and PW pinniped (approximation).

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For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Seventeen marine mammal species (15 cetacean species (6 mysticetes and 9 odontocetes) and 2 pinniped species (both phocid)) have the reasonable potential to co-occur with the proposed survey activities. Please refer back to Table 3. NMFS notes that in 2019, Southall *et al.* recommended new names for hearing groups that are widely recognized. However, this new hearing group classification does not change the weighting functions or acoustic thresholds (*i.e.,* the weighting functions and thresholds in Southall *et al.* (2019) are identical to NMFS 2018 Revised Technical Guidance). When NMFS updates our Technical Guidance, we will be adopting the updated Southall *et al.* (2019) hearing group classification.

Potential Effects to Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The Estimated Take section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The Negligible Impact Analysis and Determination section considers the content of this section, the Estimated Take section, and the Proposed Mitigation section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks. General background information on marine mammal hearing was provided previously (see the Description of Marine Mammals in the Area of Specified Activities section). Here, the potential effects of sound on marine mammals are discussed.

Ocean Wind has requested authorization for the take of marine mammals that may occur incidental to construction activities in the Ocean Wind 1 project area. Ocean Wind 1 analyzed potential impacts to marine mammals from acoustic and explosive sources in its ITA application. NMFS carefully reviewed the information provided by Ocean Wind, along with independently reviewing applicable scientific research and literature and other information to evaluate the potential effects of Ocean Wind's activities on marine mammals, which are presented in this section.

The proposed activities would result in the placement of up to 101 permanent structures (*i.e.,* the monopiles and associated scour protection supporting the WTGs and OSS, depending on the foundation scenario carried forward for the OSSs) and seven temporary cofferdams in the marine environment. Up to ten UXO/MEC detonations may occur intermittently, and only as necessary. A variety of effects on marine mammals, habitat, and prey species could occur.

Description of Sound Sources

This section contains a brief technical background on sound, on the characteristics of certain sound types, and on metrics used in this proposal inasmuch as the information is relevant to the specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document. For general information on sound and its interaction with the marine environment, please see, *e.g.,* Au and Hastings (2008); Richardson *et al.* (1995); Urick (1983).

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in Hz or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the ''loudness'' of a sound and is typically described using the relative unit of the dB. A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to $1\ \mu Pa$), while the received level is the SPL at the listener's position (referenced to $1\ \mu Pa$).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Root mean square is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Root mean square accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re 1 micropascal-squared second ($\mu Pa2$-s)) represents the total energy in a stated frequency band over a stated time interval or event, and considers both intensity and duration of exposure. The per-pulse SEL is calculated over the time window containing the entire pulse (*i.e.,* 100 percent of the acoustic energy). SEL is a cumulative metric; it can be accumulated over a single pulse, or calculated over periods containing multiple pulses. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for sound produced by the pile driving activity considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound, which is defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995). The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.,* wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.,* vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including wind and waves, which are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (ICES, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, geophysical surveys, sonar, and explosions. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 2 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

The sum of the various natural and anthropogenic sound sources that comprise ambient sound at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10–20 dB from day to day (Richardson *et al.,* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals. Underwater ambient sound in the Atlantic Ocean southeast of Rhode Island is composed of sounds produced by a number of natural and anthropogenic sources. Human-generated sound is a significant contributor to the ambient acoustic environment in the project location.

Details of source types are described in the following text.

Sounds are often considered to fall into one of two general types: Impulsive and non-impulsive (defined in the following). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing. Please see Southall *et al.* (2019) and NMFS (2018) for an in-depth discussion of these concepts. The distinction between these two sound types is not always obvious, as certain signals share properties of both impulsive and non-impulsive sounds. A signal near a source could be categorized as impulsive, but due to propagation effects as it moves farther from the source, the signal duration becomes longer (*e.g.,* Greene and Richardson, 1988).

Impulsive sound sources (*e.g.,* airguns, explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Impulsive sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features. Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-impulsive sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-impulsive sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems. The duration of such sounds can be greatly extended in a highly reverberant environment.

Potential Effects of Underwater Sound on Marine Mammals

Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. Broadly, underwater sound from active acoustic sources can potentially result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2003; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure in addition to the contextual factors of the receiver (*e.g.,* behavioral state at time of exposure, age class, *etc.*) (Southall *et al.,* 2017; Southall *et al.,* 2019). In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We describe below the specific manifestations of acoustic effects that may occur based on the activities proposed by Ocean Wind.

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First (at the greatest distance) is the area within which the acoustic signal would be audible (potentially perceived) to the animal but not strong enough to elicit any overt behavioral or physiological response. The next zone (closer to the receiving animal) corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. The third is a smaller zone around the receiving animals within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.,* when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

Potential effects from explosive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Tal *et al.,* 2015).

Below, we provide additional detail regarding potential impacts on marine mammals and their habitat from noise in general, as well as from the specific activities Ocean Wind plans to conduct, to the degree it is available (noting that there is limited information regarding the impacts of offshore wind construction on cetaceans).

Threshold Shift

Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which NMFS defines as a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level, expressed in decibels (NMFS, 2018). Threshold shifts can be permanent, in which case there is an irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range, or temporary, in which there is reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range and the animal's hearing threshold would fully recover over time (Southall *et al.,* 2019). Repeated sound exposure that leads to TTS could cause PTS.

When PTS occurs, there can be physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Henderson *et al.,* 2008). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997; Southall *et al.,* 2019). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, and there is no PTS data for cetaceans, but such relationships are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several decibels above (a 40 dB threshold shift approximates a PTS onset; *e.g.,* Kryter *et al.,* 1966; Miller, 1974; Henderson *et al.,* 2008). This can also induce mild TTS (a 6 dB threshold shift approximates a TTS onset; *e.g.,* Southall *et al.,* 2019). Based on data from terrestrial mammals, a precautionary assumption is that the

PTS thresholds, expressed in the unweighted peak sound pressure level metric (PK), for impulsive sounds (such as impact pile driving pulses) are at least 6 dB higher than the TTS thresholds and the weighted PTS cumulative sound exposure level thresholds are 15 (impulsive sound) to 20 (non-impulsive sounds) dB higher than TTS cumulative sound exposure level thresholds (Southall *et al.,* 20019). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, PTS is less likely to occur as a result of these activities, but it is possible and a small amount has been proposed for authorization for several species.

TTS is the mildest form of hearing impairment that can occur during exposure to sound, with a TTS of 6 dB considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability (Schlundt *et al.,* 2000; Finneran *et al.,* 2000; Finneran *et al.,* 2002).

While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. There are data on sound levels and durations necessary to elicit mild TTS for marine mammals but recovery is complicated to predict and dependent on multiple factors.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale (*Delphinapterus leucas*), harbor porpoise, and Yangtze finless porpoise (*Neophocoena asiaeorientalis*)) and six species of pinnipeds (northern elephant seal (*Mirounga angustirostris*), harbor seal, ring seal, spotted seal, bearded seal, and California sea lion (*Zalophus californianus*)) that were exposed to a limited number of sound sources (*i.e.,* mostly tones and octave-band noise with limited number of exposure to impulsive sources such as seismic airguns or impact pile driving) in laboratory settings (Southall *et al.,* 2019). There is currently no data available on noise-induced hearing loss for mysticetes. For summaries of data on TTS or PTS in marine mammals or for further discussion of TTS or PTS onset thresholds, please see Southall *et al.* (2019), and NMFS (2018).

Recent studies with captive odontocete species (bottlenose dolphin, harbor porpoise, beluga, and false killer whale) have observed increases in hearing threshold levels when individuals received a warning sound prior to exposure to a relatively loud sound (Nachtigall and Supin, 2013, 2015, Nachtigall *et al.,* 2016a,b,c, Finneran, 2018, Nachtigall *et al.,* 2018). These studies suggest that captive animals have a mechanism to reduce hearing sensitivity prior to impending loud sounds. Hearing change was observed to be frequency dependent and Finneran (2018) suggests hearing attenuation occurs within the cochlea or auditory nerve. Based on these observations on captive odontocetes, the authors suggest that wild animals may have a mechanism to self-mitigate the impacts of noise exposure by dampening their hearing during prolonged exposures of loud sound, or if conditioned to anticipate intense sounds (Finneran, 2018, Nachtigall *et al.,* 2018).

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately predisposed to respond to certain sounds in certain ways) (Southall *et al.,* 2019). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), the similarity of a sound to biologically relevant sounds in the animal's environment (*i.e.,* calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007, DeRuiter *et al.,* 2013). Individuals (of different age, gender, reproductive status, *etc.*) among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (*i.e.,* proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone. For example, Goldbogen *et al.* (2013) demonstrated that individual behavioral state was critically important in determining response of blue whales to sonar, noting that some individuals engaged in deep (greater than 50 m) feeding behavior had greater dive responses than those in shallow feeding or non-feeding conditions. Some blue whales in the Goldbogen *et al.* (2013) study that were engaged in shallow feeding behavior demonstrated no clear changes in diving or movement even when received levels were high (~160 dB *re 1μPa*) for exposures to 3–4 kHz sonar signals, while others showed a clear response at exposures at lower received levels of sonar and pseudorandom noise.

Studies by DeRuiter *et al.* (2012) indicate that variability of responses to acoustic stimuli depends not only on the species receiving the sound and the sound source, but also on the social, behavioral, or environmental contexts of exposure. Another study by DeRuiter *et al.* (2013) examined behavioral responses of Cuvier's beaked whales to MF sonar and found that whales responded strongly at low received levels (89–127 dB *re 1μPa*) by ceasing normal fluking and echolocation, swimming rapidly away, and extending both dive duration and subsequent non-foraging intervals when the sound source was 3.4–9.5 km away. Importantly, this study also showed that whales exposed to a similar range of received levels (78–106 dB *re 1μPa*) from distant sonar exercises (118 km away) did not elicit such responses, suggesting that context may moderate reactions. Thus, it is known that distance from the source can have an effect on behavioral response that is independent of the effect of received levels (*e.g.,* DeRuiter *et al.,* 2013; Dunlop *et al.,* 2017a; Dunlop *et al.,* 2017b; Falcone *et al.,* 2017; Dunlop *et al.,* 2018; Southall *et al.,* 2019a).

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound, but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as described, greatly influences the type of behavioral response exhibited by the animal. Forney *et al.* (2017) also point out that an apparent lack of response (*e.g.,* no displacement or avoidance of a sound source) may not necessarily mean there is no cost to the individual or population, as some resources or habitats may be of such high value that animals may choose to stay, even when experiencing stress or hearing loss. Forney *et al.* (2017) recommend considering both the costs of remaining in an area of noise exposure such as TTS, PTS, or masking, which could lead to an increased risk of predation or other threats or a decreased capability to forage, and the costs of displacement, including potential increased risk of vessel strike, increased risks of predation or competition for resources, or decreased habitat suitable for foraging, resting, or socializing. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. However, distance is one contextual factor for which data exist to quantitatively inform a take estimate, and the method for predicting Level B harassment in this rule does consider distance to the source. Other factors are often considered qualitatively in the analysis of the likely consequences of sound exposure, where supporting information is available.

Friedlaender *et al.* (2016) provided the first integration of direct measures of prey distribution and density variables incorporated into across-individual analyses of behavior responses of blue whales to sonar, and demonstrated a five-fold increase in the ability to quantify variability in blue whale diving behavior. These results illustrate that responses evaluated without such measurements for foraging animals may be misleading, which again illustrates the context-dependent nature of the probability of response. Exposure of marine mammals to sound sources can result in, but is not limited to, no response or any of the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson (1995). More recent reviews (Nowacek *et al.,* 2007; DeRuiter *et al.,* 2012 and 2013; Ellison *et al.,* 2012; Gomez *et al.,* 2016) address studies conducted since 1995 and focused on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. Gomez *et al.* (2016) conducted a review of the literature considering the contextual information of exposure in addition to received level and found that higher received levels were not always associated with more severe behavioral responses and vice versa. Southall *et al.* (2021) states that results demonstrate that some individuals of different species display clear yet varied responses, some of which have negative implications, while others appear to tolerate high levels, and that responses may not be fully predictable with simple acoustic exposure metrics (*e.g.,* received sound level). Rather, the authors state that differences among species and individuals along with contextual aspects of exposure (*e.g.,* behavioral state) appear to affect response probability. The following subsections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists, along with contextual factors.

Avoidance and Displacement

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.,* 1995). For example, gray whales or humpback whales are known to change direction—deflecting from customary migratory paths—in order to avoid noise from airgun surveys (Malme *et al.,* 1984; Dunlop *et al.,* 2018). Avoidance is qualitatively different from the flight response, but also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, *etc.*). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.,* Bowles *et al.,* 1994; Goold, 1996; Stone *et al.,* 2000; Morton and Symonds, 2002; Gailey *et al.,* 2007; Dähne *et al.,* 2013; Russel *et al.,* 2016; Malme *et al.,* 1984). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.,* Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006; Forney *et al.,* 2017). Avoidance of marine mammals during the construction of offshore wind facilities (specifically, impact pile driving) has been previously noted in the literature, with some significant variation in the effects and with most studies focused on harbor porpoises as one of the most common marine mammals in European waters (*e.g.,* Tougaard *et al.,* 2009; Dähne *et al.,* 2013; Thompson *et al.,* 2013; Russell *et al.,* 2016; Brandt *et al.,* 2018).

Available information on impacts to marine mammals from pile driving associated with offshore wind is limited to information on harbor porpoises and seals, as the vast majority of this research has occurred at European offshore wind projects where large whales and other odontocete species are uncommon. Harbor porpoises and harbor seals are considered to be behaviorally sensitive species (*e.g.,* Southall *et al.,* 2007) and the effects of wind farm construction in Europe on these species has been well documented. These species have received particular attention in European waters due to their abundance in the North Sea (Hammond *et al.,* 2002; Nachtsheim *et al.,* 2021). A summary of the literature on documented effects of wind farm construction on harbor porpoise and harbor seals is described below.

Brandt *et al.* (2016) summarized the effects of the construction of eight offshore wind projects within the German North Sea (*i.e.,* Alpha Ventus, BARD Offshore I, Borkum West II, DanTysk, Global Tech I, Meerwind Süd/Ost, Nordsee Ost, and Riffgat) between 2009 and 2013 on harbor porpoises, combining PAM data from 2010–2013 and aerial surveys from 2009–2013 with data on noise levels associated with pile driving. Results of the analysis revealed significant declines in porpoise detections during pile driving when compared to 25–48 hours before pile driving began, with the magnitude of decline during pile driving clearly decreasing with increasing distances to the construction site. During the majority of projects, significant declines in detections (by at least 20 percent) were found within at least 5–10 km of the pile driving site, with declines at up to 20–30 km of the pile driving site documented in some cases. Similar results demonstrating the long-distance displacement of harbor porpoises (18–25 km) and harbor seals (up to 40 km) during impact pile driving have also been observed during the construction at multiple other European wind farms (Haleters *et al.,* 2015; Lucke *et al.,* 2012; Dähne *et al.,* 2013; Tougaard *et al.,* 2009; Haelters *et al.,* 2015; Bailey *et al.,* 2010).

While harbor porpoises and seals tend to move several kilometers away from wind farm construction activities, the duration of displacement has been documented to be relatively temporary. In two studies at Horns Rev II using impact pile driving, harbor porpoise returned within 1–2 days following cessation of pile driving (Tougaard *et al.,* 2009; Brandt *et al.,* 2011). Similar recovery periods have been noted for harbor seals off of England during the construction of four wind farms (Carroll *et al.,* 2010; Hamre *et al.,* 2011; Hastie *et al.,* 2015; Russell *et al.,* 2016; Brasseur *et al.,* 2010). In some cases, an increase in harbor porpoise activity has been documented inside wind farm areas following construction (*e.g.,* Lindeboom *et al.,* 2011). Other studies have noted longer term impacts after impact pile driving. Near Dogger Bank in Germany, harbor porpoises continued to avoid the area for over 2 years after construction began (Gilles *et al.,* 2009). Approximately 10 years after construction of the Nysted wind farm, harbor porpoise abundance had not recovered to the original levels previously seen, although the echolocation activity was noted to have been increasing when compared to the previous monitoring period (Teilmann and Carstensen, 2012). However, overall, there are no indications for a population decline of harbor porpoises in European waters (*e.g.,* Brandt *et al.,* 2016) Notably, where significant differences in displacement and return rates have been identified for these species, the occurrence of secondary project-specific influences such as use of mitigation measures (*e.g.,* bubble curtains, acoustic deterrent devices (ADDs)) or the manner in which species use the habitat in the project area are likely the driving factors of this variation.

NMFS notes the aforementioned studies from Europe involve pile driving much smaller piles than Ocean Wind proposes to install and therefore we anticipate noise levels from impact pile driving to be louder. For this reason, we anticipate that the greater distances of displacement observed in harbor porpoise and harbor seals documented in Europe are likely to occur off of New Jersey. However, we do not anticipate any greater severity of response due to harbor porpoise and harbor seal habitat use off of New Jersey or population level consequences, similar to European findings. In many cases, harbor porpoises and harbor seals are resident to the areas where European wind farms have been constructed. However, off of New Jersey, harbor porpoises are transient (in winter when impact pile driving would not occur) and a very small percentage of the large harbor seal population are only seasonally present with no rookeries established. In summary, we anticipate that harbor porpoise and harbor seals will likely respond to pile driving by moving several kilometers away from the source; however, this impact would be temporary and, based on habitat use, not impact any critical behaviors such as foraging or calving/pupping.

It should also be noted that the only studies available on marine mammal responses to offshore wind-related pile driving have focused on species which are known to be more behaviorally sensitive to auditory stimuli than the other species that occur in the project area. Therefore, the documented behavioral responses of harbor porpoises and harbor seals to pile driving in Europe should be considered as a worst-case scenario in terms of the potential responses among all marine mammals to offshore pile driving, and these responses cannot reliably predict the responses that will occur in other marine mammal species.

Longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007). The context of the noise exposure has been shown to play an important role in the response. In the 2007–2008 Bahamas study, playback sounds of a potential predator—a killer whale—resulted in a similar but more pronounced reaction, which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area (Boyd *et al.,* 2008; Southall *et al.,* 2009; Tyack *et al.,* 2011). Southall *et al.* (2011) found that blue whales had a different response to sonar exposure depending on behavioral state, more pronounced when deep feeding/travel modes than when engaged in surface feeding.

Forney *et al.* (2017) detailed the potential effects of noise on marine mammal populations with high site fidelity, including displacement and auditory masking, noting that a lack of observed response does not imply absence of fitness costs and that apparent tolerance of disturbance may have population-level impacts that are less obvious and difficult to document. Avoidance of overlap between disturbing noise and areas and/or times of particular importance for sensitive species may be critical to avoiding population-level impacts because (particularly for animals with high site fidelity) there may be a strong motivation to remain in the area despite negative impacts. Forney *et al.* (2017) stated that, for these animals, remaining in a disturbed area may reflect a lack of alternatives rather than a lack of effects. Forney *et al.* discusses several case studies, including western Pacific gray whales, which are a small population of mysticetes believed to be adversely affected by oil and gas development off Sakhalin Island, Russia (Weller *et al.,* 2002; Reeves *et al.,* 2005). Western gray whales display a high degree of inter-annual site fidelity to the area for foraging purposes, and observations in the area during air gun surveys has shown the potential for harm caused by displacement from such an important area (Weller *et al.,* 2006; Johnson *et al.,* 2007). Forney *et al.* (2017) also discuss beaked whales, noting that anthropogenic effects in areas where they are resident could cause severe biological consequences, in part because displacement may adversely affect foraging rates, reproduction, or health, while an overriding instinct to remain could lead to more severe acute effects.

Tyack and Clark (1983) conducted playback studies of SURTASS low frequency active (LFA) sonar in a gray whale migratory corridor off California. Similar to North Atlantic right whales, gray whales migrate close to shore (approximately +2 kms) and are low frequency hearing specialists. The LFA sonar source was placed within the gray whale migratory corridor (approximately 2 km offshore) and offshore of most, but not all, migrating whales (approximately 4 km offshore). These locations influenced received levels and distance to the source. For the inshore playbacks, not unexpectedly, the louder the source level of the playback (*i.e.,* the louder the received level), whale avoided the source at greater distances. Specifically, when the source level was 170 dB rms and 178 dB rms, whales avoided the inshore source at ranges of several hundred meters, similar to avoidance responses reported by Malme *et al.* (1983, 1984). Whales exposed to source levels of 185 dB rms demonstrated avoidance levels at larger ranges of +1 km. Responses to the offshore source broadcasting at source levels of 185 and 200 dB, avoidance responses were greatly reduced. While there was observed deflection from course, in no case did a whale abandon its migratory behavior.

Flight Response

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.,* directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996; Frid and Dill, 2002). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, beaked whale strandings (Cox *et al.,* 2006; D'Amico *et al.,* 2009). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response. Flight responses of marine mammals have been documented in response to mobile high intensity active sonar (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Wensveen *et al.,* 2019), and more severe responses have been documented when sources are moving towards an animal or when they are surprised by unpredictable exposures (Watkins, 1986; Falcone *et al.,* 2017). Generally speaking, however, marine mammals would be expected to be less likely to respond with a flight response to either stationery pile driving (which they can sense is stationery and predictable) or significantly lower-level HRG surveys, unless they are within the area ensonified above behavioral harassment thresholds at the moment the source is turned on (Watkins, 1986; Falcone *et al.,* 2017).

Alteration of Diving or Movement

Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark, 2000; Costa *et al.,* 2003; Ng and Leung, 2003; Nowacek *et al.,* 2004; Goldbogen *et al.,* 2013a, 2013b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (*e.g.,* increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.,* 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them. Lastly, as noted previously, DeRuiter *et al.* (2013) noted that distance from a sound source may moderate marine mammal reactions in their study of Cuvier's beaked whales, which showed the whales swimming rapidly and silently away when a sonar signal was 3.4–9.5 km away while showing no such reaction to the same signal when the signal was 118 km away even though the received levels were similar.

Foraging

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.,* 2001; Nowacek *et al.,* 2004; Madsen *et al.,* 2006a; Yazvenko *et al.,* 2007; Southall *et al.,* 2019b). An understanding of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal can facilitate the assessment of whether foraging disruptions are likely to incur fitness consequences (Goldbogen *et al.,* 2013; Farmer *et al.,* 2018; Pirotta *et al.,* 2018; Southall *et al.,* 2019; Pirotta *et al.,* 2021).

Impacts on marine mammal foraging rates from noise exposure have been extensively documented, though there is little data regarding the impacts of offshore turbine construction specifically. Several broader examples follow, and it is reasonable to expect that exposure to noise produced during the 5-years the proposed rule would be effective could have similar impacts.

Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to air gun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006a; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the air guns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were 6 percent lower during exposure than control periods (Miller *et al.,* 2009). Miller *et al.* (2009) noted that more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior.

Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received SPLs were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. Blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, Melcón *et al.* (2012) were unable to determine if suppression of low frequency calls reflected a change in their feeding performance or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB referenced to a pressure of 1 microPascal (*re 1* μ*Pa*) (Melcón *et al.,* 2012). Results from the 2010–2011 field season of a behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012b; Southall *et al.,* 2019b). Information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal will help better inform a determination of whether foraging disruptions incur fitness consequences.

Surface feeding blue whales did not show a change in behavior in response to mid-frequency simulated and real sonar sources with received levels between 90 and 179 dB *re 1* μ*Pa,* but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter *et al.,* 2017; Goldbogen *et al.,* 2013b; Sivle *et al.,* 2015). Goldbogen *et al.* (2013b) indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

Similarly, while the rates of foraging lunges decrease in humpback whales due to sonar exposure, there was variability in the response across individuals, with one animal ceasing to forage completely and another animal starting to forage during the exposure (Sivle *et al.,* 2016). In addition, almost half of the animals that demonstrated avoidance were foraging before the exposure but the others were not; the animals that avoided while not feeding responded at a slightly lower received level and greater distance than those that were feeding (Wensveen *et al.,* 2017). These findings indicate that the behavioral state of the animal plays a role in the type and severity of a behavioral response. In fact, when the prey field was mapped and used as a covariate in similar models looking for a response in the same blue whales, the response in deep-feeding behavior by blue whales was even more apparent, reinforcing the need for contextual variables to be included when assessing behavioral responses (Friedlaender *et al.,* 2016).

Breathing

Respiration naturally varies with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey *et al.,* 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein *et al.,* 2001; Kastelein *et al.,* 2006a) and emissions for underwater data transmission (Kastelein *et al.,* 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.,* 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Vocalizations (Also See the Auditory Masking Section)

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result directly from increased vigilance (also see the *Potential Effects of Behavioral Disturbance on Marine Mammal Fitness* section) or a startle response, or from a need to compete with an increase in background noise (see Erbe *et al.,* 2016 review on communication masking), the latter of which is described more in the *Auditory Masking* section below.

For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003; Foote *et al.,* 2004) and blue increased song production (Di Iorio and Clark, 2010), while North Atlantic right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). In some cases, animals may cease or reduce sound production during production of aversive signals (Bowles *et al.,* 1994; Thode *et al.,* 2020; Cerchio *et al.,* (2014); McDonald *et al.,* (1995)). Blackwell *et al.* (2015) showed that whales increased calling rates as soon as air gun signals were detectable before ultimately decreasing calling rates at higher received levels.

Orientation

A shift in an animal's resting state or an attentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone. As previously mentioned, the responses may co-occur with other behaviors; for instance, an animal may initially orient toward a sound source, and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

Habituation and Sensitization

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a ''progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial,'' rather than as, more generally, moderation in response to human disturbance having a neutral or positive outcome (Bejder *et al.,* 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Both habituation and sensitization require an ongoing learning process. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003; Southall *et al.,* 2019b). Controlled experiments with captive marine mammals have shown pronounced behavioral reactions, including avoidance of loud sound sources (*e.g.,* Ridgway *et al.,* 1997; Finneran *et al.,* 2003; Houser *et al.,* 2013a,b; Kastelein *et al.,* 2018). Observed responses of wild marine mammals to loud impulsive sound sources (typically airguns or acoustic harassment devices) have been varied but often include avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Tougaard *et al.,* 2009; Brandt *et al.,* 2011, Brandt *et al.,* 2012, Dähne *et al.,* 2013; Brandt *et al.,* 2014; Russell *et al.,* 2016; Brandt *et al.,* 2018). However, many delphinids approach low-frequency airgun source vessels with no apparent discomfort or obvious behavioral change (*e.g.,* Barkaszi *et al.,* 2012), indicating the importance of frequency output in relation to the species' hearing sensitivity.

Stress Response

An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.,* Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.,* Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.,* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and ''distress'' is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.,* Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Romano *et al.,* 2002a). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as ''distress.'' In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003, 2017).

Auditory Masking

Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, or navigation) (Richardson *et al.,* 1995; Erbe and Farmer, 2000; Tyack, 2000; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age, or TTS hearing loss), and existing ambient noise and propagation conditions. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations. Masking can lead to behavioral changes including vocal changes (*e.g.,* Lombard effect, increasing amplitude, or changing frequency), cessation of foraging or lost foraging opportunities, and leaving an area, to both signalers and receivers, in an attempt to compensate for noise levels (Erbe *et al.,* 2016) or because sounds that would typically have triggered a behavior were not detected. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which only occurs during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.,* Clark *et al.,* 2009; Matthews *et al.,* 2016) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.,* Miller *et al.,* 2000; Foote *et al.,* 2004; Parks *et al.,* 2007; Di Iorio and Clark, 2009; Holt *et al.,* 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.,* 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.,* Erbe, 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.,* Branstetter *et al.,* 2013; Cholewiak *et al.,* 2018).

The echolocation calls of toothed whales are subject to masking by high-frequency sound. Human data indicate low-frequency sound can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high-frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A study by Nachtigall and Supin (2008) showed that false killer whales adjust their hearing to compensate for ambient sounds and the intensity of returning echolocation signals.

Impacts on signal detection, measured by masked detection thresholds, are not the only important factors to address when considering the potential effects of masking. As marine mammals use sound to recognize conspecifics, prey, predators, or other biologically significant sources (Branstetter *et al.,* 2016), it is also important to understand the impacts of masked recognition thresholds (often called ''informational masking''). Branstetter *et al.* (2016) measured masked recognition thresholds for whistle-like sounds of bottlenose dolphins and observed that they are approximately 4 dB above detection thresholds (energetic masking) for the same signals. Reduced ability to recognize a conspecific call or the acoustic signature of a predator could have severe negative impacts. Branstetter *et al.* (2016) observed that if ''quality communication'' is set at 90 percent recognition the output of communication space models (which are based on 50 percent detection) would likely result in a significant decrease in communication range.

As marine mammals use sound to recognize predators (Allen *et al.,* 2014; Cummings and Thompson, 1971; Curé *et al.,* 2015; Fish and Vania, 1971), the presence of masking noise may also prevent marine mammals from responding to acoustic cues produced by their predators, particularly if it occurs in the same frequency band. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by mammal-eating killer whales. The seals acoustically discriminate between the calls of mammal-eating and fish-eating killer whales (Deecke *et al.,* 2002), a capability that should increase survivorship while reducing the energy required to attend to all killer whale calls. Similarly, sperm whales (Curé *et al.,* 2016; Isojunno *et al.,* 2016), long-finned pilot whales (Visser *et al.,* 2016), and humpback whales (Curé *et al.,* 2015) changed their behavior in response to killer whale vocalization playbacks; these findings indicate that some recognition of predator cues could be missed if the killer whale vocalizations were masked. The potential effects of masked predator acoustic cues depends on the duration of the masking noise and the likelihood of a marine mammal encountering a predator during the time that detection and recognition of predator cues are impeded.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio.

Masking affects both senders and receivers of acoustic signals and, at higher levels and longer duration, can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009; Cholewiak *et al.,* 2018). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.,* from commercial vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

In addition to making it more difficult for animals to perceive and recognize acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the ''active space'' (or communication space) of their vocalizations, which is the maximum area within which their vocalizations can be detected before it drops to the level of ambient noise (Brenowitz, 2004; Brumm *et al.,* 2004; Lohr *et al.,* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations from other sounds, which is more important than simply detecting that a vocalization is occurring (Brenowitz, 1982; Brumm *et al.,* 2004; Dooling, 2004, Marten and Marler, 1977; Patricelli *et al.,* 2006). Most species that vocalize have evolved with an ability to make adjustments to their vocalizations to increase the signal-to-noise ratio, active space, and recognizability/distinguishability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.,* 2004; Patricelli *et al.,* 2006). Vocalizing animals can make adjustments to vocalization characteristics such as the frequency structure, amplitude, temporal structure, and temporal delivery (repetition rate), or ceasing to vocalize.

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communication between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments are not directly known in all instances, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006; Noren *et al.,* 2017; Noren *et al.,* 2020). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

Marine mammals are also known to make vocal changes in response to anthropogenic noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying (see the following for examples: Gordon *et al.,* 2003; Di Iorio and Clark, 2010; Hatch *et al.,* 2012; Holt *et a*l., 2008; Holt *et al.,* 2011; Lesage *et al.,* 1999; McDonald *et al.,* 2009; Parks *et al.,* 2007, Risch *et al.,* 2012, Rolland *et al.,* 2012), as well as changes in the natural acoustic environment (Dunlop *et al.,* 2014). Vocal changes can be temporary, or can be persistent. For example, model simulation suggests that the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years resulted in increased detection ranges between right whales. The frequency shift, coupled with an increase in call intensity by 20 dB, led to a call detectability range of less than 3 km to over 9 km (Tennessen and Parks, 2016). Holt *et al.* (2008) measured killer whale call source levels and background noise levels in the one to 40 kHz band and reported that the whales increased their call source levels by one dB SPL for every one dB SPL increase in background noise level. Similarly, another study on St. Lawrence River belugas reported a similar rate of increase in vocalization activity in response to passing vessels (Scheifele *et al.,* 2005). Di Iorio and Clark (2010) showed that blue whale calling rates vary in association with seismic sparker survey activity, with whales calling more on days with surveys than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

In some cases, these vocal changes may have fitness consequences, such as an increase in metabolic rates and oxygen consumption, as observed in bottlenose dolphins when increasing their call amplitude (Holt *et al.,* 2015). A switch from vocal communication to physical, surface-generated sounds such as pectoral fin slapping or breaching was observed for humpback whales in the presence of increasing natural background noise levels, indicating that adaptations to masking may also move beyond vocal modifications (Dunlop *et al.,* 2010).

While these changes all represent possible tactics by the sound-producing animal to reduce the impact of masking, the receiving animal can also reduce masking by using active listening strategies such as orienting to the sound source, moving to a quieter location, or reducing self-noise from hydrodynamic flow by remaining still. The temporal structure of noise (*e.g.,* amplitude modulation) may also provide a considerable release from masking through comodulation masking release (a reduction of masking that occurs when broadband noise, with a frequency spectrum wider than an animal's auditory filter bandwidth at the frequency of interest, is amplitude modulated) (Branstetter and Finneran, 2008; Branstetter *et al.,* 2013). Signal type (*e.g.,* whistles, burst-pulse, sonar clicks) and spectral characteristics (*e.g.,* frequency modulated with harmonics) may further influence masked detection thresholds (Branstetter *et al.,* 2016; Cunningham *et al.,* 2014).

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels. Several studies have shown decreases in marine mammal communication space and changes in behavior as a result of the presence of vessel noise. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007) as well as increasing the amplitude (intensity) of their calls (Parks, 2009; Parks *et al.,* 2011). Clark *et al.* (2009) also observed that right whales' communication space decreased by up to 84 percent in the presence of vessels. Cholewiak *et al.* (2018) also observed loss in communication space in Stellwagen National Marine Sanctuary for North Atlantic right whales, fin whales, and humpback whales with increased ambient noise and shipping noise. Although humpback whales off Australia did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected based on source level changes to wind noise, potentially indicating some signal masking (Dunlop, 2016). Multiple delphinid species have also been shown to increase the minimum or maximum frequencies of their whistles in the presence of anthropogenic noise and reduced communication space (for examples see: Holt *et al.,* 2008; Holt *et al.,* 2011; Gervaise *et al.,* 2012; Williams *et al.,* 2013; Hermannsen *et al.,* 2014; Papale *et al.,* 2015; Liu *et al.,* 2017). While masking impacts are not a concern from lower intensity, higher frequency HRG surveys, some degree of masking would be expected in the vicinity of turbine pile driving and concentrated support vessel operation.

Explosive Sources

Underwater explosive detonations send a shock wave and sound energy through the water and can release gaseous by-products, create an oscillating bubble, or cause a plume of water to shoot up from the water surface. The shock wave and accompanying noise are of most concern to marine animals. Depending on the intensity of the shock wave and size, location, and depth of the animal, an animal can be injured, killed, suffer non-lethal physical effects, experience hearing related effects with or without behavioral responses, or exhibit temporary behavioral responses or tolerance from hearing the blast sound. Generally, exposures to higher levels of impulse and pressure levels would result in greater impacts to an individual animal.

Injuries resulting from a shock wave take place at boundaries between tissues of different densities. Different velocities are imparted to tissues of different densities, and this can lead to their physical disruption. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000). Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, petechiae (small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

Because the ears are the most sensitive to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related damage associated with sound energy from detonations can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. If a noise is audible to an animal, it has the potential to damage the animal's hearing by causing decreased sensitivity (Ketten, 1995). Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source and are not, technically, pure acoustic trauma (Ketten, 1995). Sublethal impacts include hearing loss, which is caused by exposures to perceptible sounds. Severe damage (from the shock wave) to the ears includes tympanic membrane rupture, fracture of the ossicles, and damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear. Moderate injury implies partial hearing loss due to tympanic membrane rupture and blood in the middle ear. Permanent hearing loss also can occur when the hair cells are damaged by one very loud event, as well as by prolonged exposure to a loud noise or chronic exposure to noise. The level of impact from blasts depends on both an animal's location and, at outer zones, on its sensitivity to the residual noise (Ketten, 1995).

Given the mitigation measures proposed, and the small number of detonations proposed, it is unlikely that any of the more serious injuries or mortality discussed above are likely to result from any UXO/MEC detonation that Ocean Wind might need to undertake. TTS and brief startle reactions are the most likely impacts to result from this activity.

Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, *etc.*) of an animal. There is little quantitative marine mammal data relating the exposure of marine mammals from sound to effects on reproduction or survival, though data exists for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli may cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); may cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or may cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

One consequence of behavioral avoidance results in the altered energetic expenditure of marine mammals because energy is required to move and avoid surface vessels or the sound field associated with active sonar (Frid and Dill, 2002). Most animals can avoid that energetic cost by swimming away at slow speeds or speeds that minimize the cost of transport (Miksis-Olds, 2006), as has been demonstrated in Florida manatees (Miksis-Olds, 2006).

Those energetic costs increase, however, when animals shift from a resting state, which is designed to conserve an animal's energy, to an active state that consumes energy the animal would have conserved had it not been disturbed. Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting to active behavioral states, which would imply that they incur an energy cost.

Morete *et al.,* (2007) reported that undisturbed humpback whale cows that were accompanied by their calves were frequently observed resting while their calves circled them (milling). When vessels approached, the amount of time cows and calves spent resting and milling, respectively, declined significantly. These results are similar to those reported by Scheidat *et al.* (2004) for the humpback whales they observed off the coast of Ecuador.

Constantine and Brunton (2001) reported that bottlenose dolphins in the Bay of Islands, New Zealand engaged in resting behavior just 5 percent of the time when vessels were within 300 m, compared with 83 percent of the time when vessels were not present. However, Heenehan *et al.* (2016) report that results of a study of the response of Hawaiian spinner dolphins (*Stenella longirostris*) to human disturbance suggest that the key factor is not the sheer presence or magnitude of human activities, but rather the directed interactions and dolphin-focused activities that elicit responses from dolphins at rest. This information again illustrates the importance of context in regard to whether an animal will respond to a stimulus. Miksis-Olds (2006) and Miksis-Olds *et al.* (2005) reported that Florida manatees in Sarasota Bay, Florida, reduced the amount of time they spent milling and increased the amount of time they spent feeding when background noise levels increased. Although the acute costs of these changes in behavior are not likely to exceed an animal's ability to compensate, the chronic costs of these behavioral shifts are uncertain.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or subconsciously (for example, when an animal hears sounds that it associates with the approach of a predator) and the shift in attention can be sudden (Dukas, 2002; van Rij, 2007). Once a stimulus has captured an animal's attention, the animal can respond by ignoring the stimulus, assuming a ''watch and wait'' posture, or treat the stimulus as a disturbance and respond accordingly, which includes scanning for the source of the stimulus or ''vigilance'' (Cowlishaw *et al.,* 2004).

Vigilance is an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time; when animals focus their attention on specific environmental cues, they are not attending to other activities such as foraging or resting. These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (*e.g.,* when they are giving birth or accompanied by a calf). Most of the published literature, however, suggests that direct approaches will increase the amount of time animals will dedicate to being vigilant. An example of this concept with terrestrial species involved bighorn sheep and Dall's sheep, which dedicated more time being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991). Vigilance has also been documented in pinnipeds at haul out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007; VanBlaricom, 2010; and Lozano and Hente, 2014).

Chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.,* Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46 percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17 percent reproductive success rate. Similar reductions in reproductive success have been reported for mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou (*Rangifer tarandus caribou*) disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), and caribou disturbed by low-elevation military jet fights (Luick *et a*l., 1996, Harrington and Veitch, 1992). Similarly, a study of elk (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a 5-day period in open-air, open-water enclosures in San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels.

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). An example of this concept with terrestrial species involved a study of grizzly bears (*Ursus horribilis*) that reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2 × 103 kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999).

Lusseau and Bejder (2007) present data from three long-term studies illustrating the connections between disturbance from whale-watching boats and population-level effects in cetaceans. In Shark Bay, Australia, the abundance of bottlenose dolphins was compared within adjacent control and tourism sites over three consecutive 4.5-year periods of increasing tourism levels. Between the second and third time periods, in which tourism doubled, dolphin abundance decreased by 15 percent in the tourism area and did not change significantly in the control area. In Fiordland, New Zealand, two populations (Milford and Doubtful Sounds) of bottlenose dolphins with tourism levels that differed by a factor of seven were observed and significant increases in traveling time and decreases in resting time were documented for both. Consistent short-term avoidance strategies were observed in response to tour boats until a threshold of disturbance was reached (average 68 minutes between interactions), after which the response switched to a longer-term habitat displacement strategy. For one population, tourism only occurred in a part of the home range. However, tourism occurred throughout the home range of the Doubtful Sound population and once boat traffic increased beyond the 68-minute threshold (resulting in abandonment of their home range/preferred habitat), reproductive success drastically decreased (increased stillbirths) and abundance decreased significantly (from 67 to 56 individuals in a short period). Last, in a study of northern resident killer whales off Vancouver Island, exposure to boat traffic was shown to reduce foraging opportunities and increase traveling time. A simple bioenergetics model was applied to show that the reduced foraging opportunities equated to a decreased energy intake of 18 percent, while the increased traveling incurred an increased energy output of 3–4 percent, which suggests that a management action based on avoiding interference with foraging might be particularly effective.

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant for fitness if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). It is important to note the difference between behavioral reactions lasting or recurring over multiple days and anthropogenic activities lasting or recurring over multiple days. For example, just because certain activities last for multiple days does not necessarily mean that individual animals will be either exposed to those activity-related stressors (*i.e.,* sonar) for multiple days or further, exposed in a manner that would result in sustained multi-day substantive behavioral responses; however, special attention is warranted where longer-duration activities overlay areas in which animals are known to congregate for longer durations for biologically important behaviors.

Stone (2015a) reported data from at-sea observations during 1,196 airgun surveys from 1994 to 2010. When large arrays of airguns (considered to be 500 in 3 or more) were firing, lateral displacement, more localized avoidance, or other changes in behavior were evident for most odontocetes. However, significant responses to large arrays were found only for the minke whale and fin whale. Behavioral responses observed included changes in swimming or surfacing behavior, with indications that cetaceans remained near the water surface at these times. Cetaceans were recorded as feeding less often when large arrays were active. Behavioral observations of gray whales during an air gun survey monitored whale movements and respirations pre-, during-, and post-seismic survey (Gailey *et al.,* 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and, after considering natural variation, none of the response variables were significantly associated with survey or vessel sounds.

In order to understand how the effects of activities may or may not impact species and stocks of marine mammals, it is necessary to understand not only what the likely disturbances are going to be, but how those disturbances may affect the reproductive success and survivorship of individuals, and then how those impacts to individuals translate to population-level effects. Following on the earlier work of a committee of the U.S. National Research Council (NRC, 2005), New *et al.* (2014), in an effort termed the Potential Consequences of Disturbance (PCoD), outline an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. In this framework, behavioral and physiological changes can have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation; they can have indirect and long-term (chronic) effects on vital rates, such as when changes in time/energy budgets or increased disease susceptibility affect health, which then affects vital rates; or they can have no effect to vital rates (New *et al.,* 2014). In addition to outlining this general framework and compiling the relevant literature that supports it, the authors chose four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, *Ziphiidae* beaked whales, and bottlenose dolphins) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts from behavioral changes. While these are very specific models with very specific data requirements that cannot yet be applied broadly to project-specific risk assessments for the majority of species, they are a critical first step towards being able to quantify the likelihood of a population level effect.

Since New *et al.* (2014), several publications have described models developed to examine the long-term effects of environmental or anthropogenic disturbance of foraging on various life stages of selected species (sperm whale, Farmer *et al.,* (2018); California sea lion, McHuron *et al.,* (2018); blue whale, Pirotta *et al.,* (2018a)). These models continue to add to refinement of the approaches to the Population Consequences of Disturbance (PCOD) framework. Such models also help identify what data inputs require further investigation. Pirotta *et al.* (2018b) provides a review of the PCOD framework with details on each step of the process and approaches to applying real data or simulations to achieve each step.

New *et al.* (2020) found that closed populations of dolphins could not withstand a higher probability of disturbance, compared to open populations with no limitation on food. Two bottlenose dolphin populations in Australia were also modeled over 5 years against a number of disturbances, (Reed *et al.,* 2020) and results indicated that habitat/noise disturbance had little overall impact on population abundances in either location, even in the most extreme impact scenarios modeled. By integrating different sources of data (*e.g.,* controlled exposure data, activity monitoring, telemetry tracking, and prey sampling) into a theoretical model to predict effects from sonar on a blue whale's daily energy intake, Pirotta *et al.* (2021) found that tagged blue whales' activity budgets, lunging rates, and ranging patterns caused variability in their predicted cost of disturbance. Dunlop *et al.* (2021) modeled migrating humpback whale mother-calf pairs in response to seismic surveys using both a forwards and backwards approach. While a typical forwards approach can determine if a stressor would have population-level consequences, Dunlop *et al.* demonstrated that working backwards through a PCoD model can be used to assess the ''worst case'' scenario for an interaction of a target species and stressor. This method may be useful for future management goals when appropriate data becomes available to fully support the model. Harbor porpoise movement and foraging were modeled for baseline periods and then for periods with seismic surveys as well; the models demonstrated that the seasonality of the seismic activity was an important predictor of impact (Gallagher *et al.,* 2021).

Nearly all PCoD studies and experts agree that infrequent exposures of a single day or less are unlikely to impact individual fitness, let alone lead to population level effects (Booth *et al.,* 2016; Booth *et al.,* 2017; Christiansen and Lusseau 2015; Farmer *et al.,* 2018; Wilson *et al.,* 2020; Harwood and Booth 2016; King *et al.,* 2015; McHuron *et al.,* 2018; NAS 2017; New *et al.,* 2014; Pirotta *et al.,* 2018; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015). Since NMFS expects that any exposures would be very brief, and repeat exposures to the same individuals are unlikely, any behavioral responses that would occur due to animals being exposed to construction activity are expected to be temporary, with behavior returning to a baseline state shortly after the acoustic stimuli ceases. Given this, and NMFS' evaluation of the available PCoD studies, any such behavioral responses are not expected to impact individual animals' health or have effects on individual animals' survival or reproduction, thus no detrimental impacts at the population level are anticipated. North Atlantic right whales may temporarily avoid the immediate area but are not expected to permanently abandon the area or their migratory behavior. Impacts to breeding, feeding, sheltering, resting, or migration are not expected, nor are shifts in habitat use, distribution, or foraging success. NMFS does not anticipate North Atlantic right whale takes that would result from the proposed project would impact annual rates of recruitment or survival. Thus, any takes that occur would not result in population level impacts.

Potential Effects of Vessel Strike

Vessel collisions with marine mammals, also referred to as vessel strikes or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. Superficial strikes may not kill or result in the death of the animal. Lethal interactions are typically associated with large whales, which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007; Conn and Silber, 2013). Impact forces increase with speed, as does the probability of a strike at a given distance (Silber *et al.,* 2010; Gende *et al.,* 2011).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some baleen whales seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). These species are primarily large, slow moving whales. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike occurs and, if so, whether it results in injury, serious injury, or mortality (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Pace and Silber, 2005; Vanderlaan and Taggart, 2007; Conn and Silber 2013). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 13 kn.

Jensen and Silber (2003) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these 58 cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 kn. The majority (79 percent) of these strikes occurred at speeds of 13 kn or greater. The average speed that resulted in serious injury or death was 18.6 kn. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded 90 percent at 17 kn. Higher speeds during collisions result in greater force of impact and also appear to increase the chance of severe injuries or death. While modeling studies have suggested that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne, 1999; Knowlton *et al.,* 1995), this is inconsistent with Silber *et al.* (2010), which demonstrated that there is no such relationship (*i.e.,* hydrodynamic forces are independent of speed).

In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between 8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward 100 percent above 15 kn.

The Jensen and Silber (2003) report notes that the Large Whale Ship Strike Database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, Ocean Wind's personnel are likely to detect any strike that does occur because of the required personnel training and lookouts, along with the inclusion of Protected Species Observers (as described in the Proposed Mitigation section), and they are required to report all ship strikes involving marine mammals.

In the Ocean Wind project area, NMFS has no documented vessel strikes of marine mammals by Ocean Wind or Orsted during previous site characterization surveys. Given the extensive mitigation and monitoring measures (see the Proposed Mitigation and Proposed Monitoring and Reporting section) that would be required of Ocean Wind, NMFS believes that vessel strike is not likely to occur.

Marine Mammal Habitat

Ocean Wind's proposed construction activities could potentially affect marine mammal habitat through the introduction of impacts to the prey species of marine mammals, acoustic habitat (sound in the water column), water quality, and important habitat for marine mammals.

The presence of structures such as wind turbines are likely to result in both local and broader oceanographic effects. However, the scale of impacts is difficult to predict and may vary from hundreds of meters for local individual turbine impacts (Schultze *et al.,* 2020) to large-scale dipoles of surface elevation changes stretching hundreds of kilometers (Christiansen *et al.,* 2022).

Effects on Prey

Sound may affect marine mammals through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, and zooplankton). Marine mammal prey varies by species, season, and location and, for some, is not well documented. Here, we describe studies regarding the effects of noise on known marine mammal prey.

Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al.,* 1999; Fay, 2009). The most likely effects on fishes exposed to loud, intermittent, low-frequency sounds are behavioral responses (*i.e.,* flight or avoidance). Short duration, sharp sounds (such as pile driving or air guns) can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to acoustic sources depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality. While it is clear that the behavioral responses of individual prey, such as displacement or other changes in distribution, can have direct impacts on the foraging success of marine mammals, the effects on marine mammals of individual prey that experience hearing damage, barotrauma, or mortality is less clear, though obviously population scale impacts that meaningfully reduce the amount of prey available could have more serious impacts.

Fishes, like other vertebrates, have a variety of different sensory systems to glean information from ocean around them (Astrup and Mohl, 1993; Astrup, 1999; Braun and Grande, 2008; Carroll *et al.,* 2017; Hawkins and Johnstone, 1978; Ladich and Popper, 2004; Ladich and Schulz-Mirbach, 2016; Mann, 2016; Nedwell *et al.,* 2004; Popper *et al.,* 2003; Popper *et al.,* 2005). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008) (terrestrial vertebrates generally only detect pressure). Most marine fishes primarily detect particle motion using the inner ear and lateral line system, while some fishes possess additional morphological adaptations or specializations that can enhance their sensitivity to sound pressure, such as a gas-filled swim bladder (Braun and Grande, 2008; Popper and Fay, 2011).

Hearing capabilities vary considerably between different fish species with data only available for just over 100 species out of the 34,000 marine and freshwater fish species (Eschmeyer and Fong, 2016). In order to better understand acoustic impacts on fishes, fish hearing groups are defined by species that possess a similar continuum of anatomical features which result in varying degrees of hearing sensitivity (Popper and Hastings, 2009a). There are four hearing groups defined for all fish species (modified from Popper *et al.,* 2014) within this analysis and they include: Fishes without a swim bladder (*e.g.,* flatfish, sharks, rays, *etc.*); fishes with a swim bladder not involved in hearing (*e.g.,* salmon, cod, pollock, *etc.*); fishes with a swim bladder involved in hearing (*e.g.,* sardines, anchovy, herring, *etc.*); and fishes with a swim bladder involved in hearing and high-frequency hearing (*e.g.,* shad and menhaden). Most marine mammal fish prey species would not be likely to perceive or hear mid- or high-frequency sonars. While hearing studies have not been done on sardines and northern anchovies, it would not be unexpected for them to have hearing similarities to Pacific herring (up to 2–5 kHz) (Mann *et al.,* 2005). Currently, less data are available to estimate the range of best sensitivity for fishes without a swim bladder.

In terms of physiology, multiple scientific studies have documented a lack of mortality or physiological effects to fish from exposure to low- and mid-frequency sonar and other sounds (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim and Sevaldsen, 2005; Popper *et al.,* 2007; Popper *et al.,* 2016; Watwood *et al.,* 2016). Techer *et al.* (2017) exposed carp in floating cages for up to 30 days to low-power 23 and 46 kHz source without any significant physiological response. Other studies have documented either a lack of TTS in species whose hearing range cannot perceive sonar (such as Navy sonar), or for those species that could perceive sonar-like signals, any TTS experienced would be recoverable (Halvorsen *et al.,* 2012; Ladich and Fay, 2013; Popper and Hastings, 2009a, 2009b; Popper *et al.,* 2014; Smith, 2016). Only fishes that have specializations that enable them to hear sounds above about 2,500 Hz (2.5 kHz) such as herring (Halvorsen *et al.,* 2012; Mann *et al.,* 2005; Mann, 2016; Popper *et al.,* 2014) would have the potential to receive TTS or exhibit behavioral responses from exposure to mid-frequency sonar. In addition, any sonar induced TTS to fish whose hearing range could perceive sonar would only occur in the narrow spectrum of the source (*e.g.,* 3.5 kHz) compared to the fish's total hearing range (*e.g.,* 0.01 kHz to 5 kHz).

In terms of behavioral responses, Juanes *et al.* (2017) discuss the potential for negative impacts from anthropogenic noise on fish, but the author's focus was on broader based sounds, such as ship and boat noise sources. Watwood *et al.* (2016) also documented no behavioral responses by reef fish after exposure to mid-frequency active sonar. Doksaeter *et al.* (2009; 2012) reported no behavioral responses to mid-frequency sonar (such as naval sonar) by Atlantic herring; specifically, no escape reactions (vertically or horizontally) were observed in free swimming herring exposed to mid-frequency sonar transmissions. Based on these results (Doksaeter *et al.,* 2009; Doksaeter *et al.,* 2012; Sivle *et al.,* 2012), Sivle *et al.* (2014) created a model in order to report on the possible population-level effects on Atlantic herring from active sonar. The authors concluded that the use of sonar poses little risk to populations of herring regardless of season, even when the herring populations are aggregated and directly exposed to sonar. Finally, Bruintjes *et al.* (2016) commented that fish exposed to any short-term noise within their hearing range might initially startle, but would quickly return to normal behavior.

Occasional behavioral reactions to activities that produce underwater noise sources are unlikely to cause long-term consequences for individual fish or populations. The most likely impact to fish from impact and vibratory pile driving activities at the project areas would be temporary behavioral avoidance of the area. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity. The duration of fish avoidance of an area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the expected short daily duration of individual pile driving events and the relatively small areas being affected.

SPLs of sufficient strength have been known to cause injury to fish and fish mortality. However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen *et al.* (2012a) showed that a TTS of 4–6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long. Injury caused by barotrauma can range from slight to severe and can cause death, and is most likely for fish with swim bladders. Barotrauma injuries have been documented during controlled exposure to impact pile driving (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013). As described in the Proposed Mitigation section below, Ocean Wind would utilize a sound attenuation device which would reduce potential for injury to marine mammal prey. Other fish that experience hearing loss as a result of exposure to explosions and impulsive sound sources may have a reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. However, PTS has not been known to occur in fishes and any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Popper *et al.,* 2005; Popper *et al.,* 2014; Smith *et al.,* 2006). It is not known if damage to auditory nerve fibers could occur, and if so, whether fibers would recover during this process.

It is also possible for fish to be injured or killed by an explosion from UXO/MEC detonation. Physical effects from pressure waves generated by underwater sounds (*e.g.,* underwater explosions) could potentially affect fish within proximity of training or testing activities. The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin and Hempen, 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen, 1997; Wright, 1982). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran, 2006; O'Keeffe, 1984; O'Keeffe and Young, 1984; Wiley *et al.,* 1981; Yelverton *et al.,* 1975). Species with gas-filled organs are more susceptible to injury and mortality than those without them (Gaspin, 1975; Gaspin *et al.,* 1976; Goertner *et al.,* 1994). Barotrauma injuries have been documented during controlled exposure to impact pile driving (an impulsive noise source, as are explosives and air guns) (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013).

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation. The abundances of various fish (and invertebrates) near the detonation point for explosives could be altered for a few hours before animals from surrounding areas repopulate the area. However, these populations would likely be replenished as waters near the detonation point are mixed with adjacent waters. Repeated exposure of individual fish to sounds from underwater explosions is not likely and are expected to be short-term and localized. Long-term consequences for fish populations would not be expected. Several studies have demonstrated that air gun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017).

UXO/MEC detonations would be dispersed in space and time; therefore, repeated exposure of individual fishes are unlikely. Mortality and injury effects to fishes from explosives would be localized around the area of a given in-water explosion, but only if individual fish and the explosive (and immediate pressure field) were co-located at the same time. Fishes deeper in the water column or on the bottom would not be affected by water surface explosions. Repeated exposure of individual fish to sound and energy from underwater explosions is not likely given fish movement patterns, especially schooling prey species. Most acoustic effects, if any, are expected to be short-term and localized. Long-term consequences for fish populations including key prey species within the project area would not be expected.

Furthermore, required soft-starts would allow prey and marine mammals to move away from the source prior to any noise levels that may physically injure prey and the use of the noise attenuation devices would reduce noise levels to the degree any mortality or injury of prey is also minimized. Use of bubble curtains, in addition to reducing impacts to marine mammals, for example, is a key mitigation measure in reducing injury and mortality of ESA-listed salmon on the West Coast. However, we recognize some mortality, physical injury and hearing impairment in marine mammal prey may occur but we anticipate the amount of prey impacted in this manner is minimal compared to overall availability. Any behavioral responses to pile driving by marine mammal prey are expected to be brief. We expect that other impacts such as stress or masking would occur in fish that serve as marine mammals prey (Thomas *et al.,* 2006); however, those impacts would be limited to the duration of impact pile driving and during any UXO/MEC detonations and, if prey were to move out the area in response to noise, these impacts would be minimized.

In addition to fish, prey sources such as marine invertebrates could potentially be impacted by noise stressors as a result of the proposed activities. However, most marine invertebrates' ability to sense sounds is limited. Invertebrates appear to be able to detect sounds (Pumphrey, 1950; Frings and Frings, 1967) and are most sensitive to low-frequency sounds (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Data on response of invertebrates such as squid, another marine mammal prey species, to anthropogenic sound are more limited (de Soto, 2016; Sole *et al.,* 2017b). Data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect air gun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Sole *et al.* (2017b) reported physiological injuries to cuttlefish in cages placed at-sea when exposed during a controlled exposure experiment to low-frequency sources (315 Hz, 139 to 142 dB *re 1* μPa^2 and 400 Hz, 139 to 141 dB *re 1* μPa^2). Fewtrell and McCauley (2012) reported squids maintained in cages displayed startle responses and behavioral changes when exposed to seismic air gun sonar (136–162 *re 1* $\mu Pa^2 \cdot s$). Jones *et al.* (2020) found that when squid (*Doryteuthis pealeii*) were exposed to impulse pile driving noise, body pattern changes, inking, jetting, and startle responses were observed and nearly all squid exhibited at least one response. However, these responses occurred primarily during the first eight impulses and diminished quickly, indicating potential rapid, short-term habituation. Cephalopods have a specialized sensory organ inside the head called a statocyst that may help an animal determine its position in space (orientation) and maintain balance (Budelmann, 1992). Packard *et al.* (1990) showed that cephalopods were sensitive to particle motion, not sound pressure, and Mooney *et al.* (2010) demonstrated that squid statocysts act as an accelerometer through which particle motion of the sound field can be detected. Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014). Squids, like most fish species, are likely more sensitive to low frequency sounds, and may not perceive mid- and high-frequency sonars. Cumulatively for squid as a prey species, individual and population impacts from exposure to explosives, like fish, are not likely to be significant, and explosive impacts would be short-term and localized.

Explosions could kill or injure nearby marine invertebrates. Vessels also have the potential to impact marine invertebrates by disturbing the water column or sediments, or directly striking organisms (Bishop, 2008). The propeller wash (water displaced by propellers used for propulsion) from vessel movement and water displaced from vessel hulls can potentially disturb marine invertebrates in the water column and is a likely cause of zooplankton mortality (Bickel *et al.,* 2011). The localized and short-term exposure to explosions or vessels could displace, injure, or kill zooplankton, invertebrate eggs or larvae, and macro-invertebrates. However, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall populations.

Impacts to benthic communities from impulsive sound generated by active acoustic sound sources are not well documented. (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). There are no published data that indicate whether temporary or permanent threshold shifts, auditory masking, or behavioral effects occur in benthic invertebrates (Hawkins *et al.,* 2014) and some studies showed no short-term or long-term effects of air gun exposure (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). Exposure to air gun signals was found to significantly increase mortality in scallops, in addition to causing significant changes in behavioral patterns during exposure (Day *et al.,* 2017). However, the authors state that the observed levels of mortality were not beyond naturally occurring rates. Explosions and pile driving could potentially kill or injure nearby marine invertebrates; however, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall populations.

The presence of large numbers of turbines has been shown to impact meso and sub-meso-scale water column circulation, which can affect the density, distribution, and energy content of zooplankton, and thereby their availability as marine mammal prey. Ocean Wind intends to have up to 68 operational by 2024, with the other 30 WTG installed and operational by either late 2024 or 2025. As described above, there is scientific uncertainty around the scale of impacts (meters to kilometers). Ocean Wind 1 is located in an area of the Mid-Atlantic Bight that experiences coastal upwelling, a consequence of the predominant wind direction and the orientation of the coastline. Along the coast of New Jersey, upwelling of deeper, nutrient-rich waters frequently leads to late summer blooms of phytoplankton and subsequently increased biological productivity (Gong *et al.,* 2010; Glenn *et al.,* 2004). However, the project area does not include key foraging grounds for marine mammals with planktonic diets (*e.g.,* North Atlantic right whale). Ocean Wind 1 is also located on the inshore edge of the Cold Pool. While there may be localized oceanographic impacts from operation, the footprint of those impacts relative to the scale of the Cold Pool itself. Overall, any impact to plankton aggregation, and hence availability as marine mammal prey, from turbine presence and operation during the effective period of the proposed rule is likely to be very limited.

Overall, the combined impacts of sound exposure, explosions, and oceanographic impacts on marine mammal habitat resulting from the proposed activities would not be expected to have measurable effects on populations of marine mammal prey species. Prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects.

Acoustic Habitat

Acoustic habitat is the soundscape, which encompasses all of the sound present in a particular location and time, as a whole when considered from the perspective of the animals experiencing it. Animals produce sound for, or listen for sounds produced by, conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.,* produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic or may be intentionally introduced to the marine environment for data acquisition purposes (as in the use of air gun arrays) or for Navy training and testing purposes (as in the use of sonar and explosives and other acoustic sources). Anthropogenic noise varies widely in its frequency, content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please also see the previous discussion on Masking), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). For more detail on these concepts see, *e.g.,* Barber *et al.,* 2009; Pijanowski *et al.,* 2011; Francis and Barber, 2013; Lillis *et al.,* 2014.

The term ''listening area'' refers to the region of ocean over which sources of sound can be detected by an animal at the center of the space. Loss of communication space concerns the area over which a specific animal signal, used to communicate with conspecifics in biologically important contexts (*e.g.,* foraging, mating), can be heard, in noisier relative to quieter conditions (Clark *et al.,* 2009). Lost listening area concerns the more generalized contraction of the range over which animals would be able to detect a variety of signals of biological importance, including eavesdropping on predators and prey (Barber *et al.,* 2009). Such metrics do not, in and of themselves, document fitness consequences for the marine animals that live in chronically noisy environments. Long-term population-level consequences mediated through changes in the ultimate survival and reproductive success of individuals are difficult to study, and particularly so underwater. However, it is increasingly well documented that aquatic species rely on qualities of natural acoustic habitats, with researchers quantifying reduced detection of important ecological cues (*e.g.,* Francis and Barber, 2013; Slabbekoorn *et al.,* 2010) as well as survivorship consequences in several species (*e.g.,* Simpson *et al.,* 2014; Nedelec *et al.,* 2015).

Sound produced from construction activities in the Ocean Wind 1 project area is temporary and transitory. The sounds produced during construction activities may be widely dispersed or concentrated in small areas for varying periods. Any anthropogenic noise attributed to construction activities in the project area would be temporary and the affected area would be expected to immediately return to the original state when these activities cease.

Water Quality

Indirect effects of explosives and unexploded ordnance to marine mammals via sediment is possible in the immediate vicinity of the ordnance. Degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo, 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6–12 in (0.15–0.3 m) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3–6 ft (1–2 m) from the degrading ordnance. Taken together, it is possible that marine mammals could be exposed to degrading explosives, but it would be within a very small radius of the explosive (1–6 ft (0.3–2 m)).

Equipment used by Ocean Wind within the project area, including ships and other marine vessels, potentially aircrafts, and other equipment, are also potential sources of by-products. All equipment is properly maintained in accordance with applicable legal requirements. All such operating equipment meets Federal water quality standards, where applicable.

Preliminary Conclusion

The most likely impact to marine mammal habitat from the project is expected to be from impact and vibratory pile driving and UXO/MEC detonations, which may affect marine mammal food sources such as forage fish and could also affect acoustic habitat (see the *Auditory Masking* section) effects on marine mammal prey (*e.g.,* fish).

The most likely impact to fish from impact and vibratory pile driving activities at the project areas would be temporary behavioral avoidance of the area. The duration of fish avoidance of an area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be relatively minor and temporary due to the expected short daily duration of individual pile driving events and the relatively small areas being affected. The most likely impacts of prey fish from UXO/MEC detonations, if determined to be necessary, are injury or mortality if they are located within the vicinity when detonation occurs. However, given the likely spread of any UXOs/MECs in the project area, the low chance of detonation (as lift-and-shift and deflagration are the primary removal approaches), and that this area is not a biologically important foraging ground, overall effects should be minimal to marine mammal species. NMFS does not expect HRG acoustic sources to impact fish and most sources are likely outside the hearing range of the primary prey species in the project area. As described previously, the placement and operation of wind turbines can also impact hydrographic patterns, though these impacts assessed through this rule are expected to be minimal given the small number of turbines that will be operational and the short amount of time covered under the rule.

These potential impacts on prey could impact the distribution of marine mammals within the project area, potentially necessitating additional energy expenditure to find and capture prey, but at the temporal and spatial scales anticipated for this activity are not expected to impact the reproduction or survival of any individual marine mammals. Although studies assessing the impacts of offshore wind development on marine mammals are limited, the repopulation of wind energy areas by harbor porpoises (Brandt *et al.,* 2016; Lindeboom *et al.,* 2011) and harbor seals (Lindeboom *et al.,* 2011; Russell *et al.,* 2016) following the installation of wind turbines are promising.

Impacts to the immediate substrate during installation of piles are anticipated, but these would be limited to minor, temporary suspension of sediments, which could impact water quality and visibility for a short amount of time, but which would not be expected to have any effects on individual marine mammals.

Ocean Wind 1 would be located within the migratory corridor BIA for North Atlantic right whales; however, the 68,450 acre (277 km^2) lease area occupies a fraction of the available habitat for North Atlantic right whales migrating through the region (66,591,935 acres; 269,488 km^2). There are no known foraging hotspots, or other ocean bottom structures of significant biological importance to marine mammals present in the project area.

Based on the information discussed herein, NMFS concludes that any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this rulemaking, which will inform both NMFS' consideration of ''small numbers'' and the negligible impact determination.

Authorized takes would primarily be by Level B harassment, as use of the acoustic sources (*i.e.,* impact and vibratory pile driving, site characterization surveys, and UXO/MEC detonations) have the potential to result in disruption of marine mammal behavioral patterns due to exposure to elevated noise levels. Impacts such as masking and TTS can contribute to behavioral disturbances. There is also some potential for auditory injury (Level A harassment) to occur in select marine mammal species incidental to the specified activities (*i.e.,* impact pile driving and UXO/MEC detonations). For this action, this potential is limited to mysticetes, high frequency cetaceans, and phocids due to their hearing sensitivities and the nature of the activities. As described below, the larger distances to the PTS thresholds, when considering marine mammal weighting functions, demonstrate this potential. For mid-frequency hearing sensitivities, when thresholds and weighting and the associated PTS zone sizes are considered, the potential for PTS from the noise produced by the project is negligible. The proposed mitigation and monitoring measures are expected to minimize the severity of the taking to the extent practicable.

As described previously, no serious injury or mortality is anticipated or proposed to be authorized for this activity. Below we describe how the take is estimated.

Generally speaking, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) and the number of days of activities. We note that while these basic factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.,* previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the proposed take estimate.

Marine Mammal Acoustic Thresholds

NMFS recommends the use of acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment). Thresholds have also been developed to identify the levels above which animals may incur different types of tissue damage (non-acoustic Level A harassment or mortality) from exposure to pressure waves from explosive detonation. Thresholds have also been developed identifying the received level of in-air sound above which exposed pinnipeds would likely be behaviorally harassed. A summary of all NMFS' thresholds can be found at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*).

Level B harassment—Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source or exposure context (*e.g.,* frequency, predictability, duty cycle, duration of the exposure, signal-to-noise ratio, distance to the source), the environment (*e.g.,* other noises in the area) and the receiving animals (hearing, motivation, experience, demography, life stage, depth) and can be difficult to predict (*e.g.,* Southall *et al.,* 2007, 2021; Ellison *et al.,* 2012). Based on what the available science indicates and the practical need to use a threshold based on a metric that is both predictable and measurable for most activities, NMFS typically uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS generally predicts that marine mammals are likely to be behaviorally harassed in a manner considered to be Level B harassment when exposed to underwater anthropogenic noise above root-mean-squared pressure received levels (RMS SPL) of 120 dB (referenced to 1 micropascal (*re 1 μPa*)) for continuous (*e.g.,* vibratory pile driving, drilling) and above RMS SPL 160 dB *re 1 μPa* for non-explosive impulsive (*e.g.,* seismic airguns) or intermittent (*e.g.,* scientific sonar) sources (Table 5). Generally speaking, Level B harassment take estimates based on these behavioral harassment thresholds are expected to include any likely takes by TTS as, in most cases, the likelihood of TTS occurs at distances from the source less than those at which behavioral harassment is likely. TTS of a sufficient degree can manifest as behavioral harassment, as reduced hearing sensitivity and the potential reduced opportunities to detect important signals (conspecific communication, predators, prey) may result in changes in behavior patterns that would not otherwise occur.

Ocean Wind's construction activities include the use of continuous (*e.g.,* vibratory pile driving), intermittent (*e.g.,* impact pile driving, HRG acoustic sources), and impulsive (*e.g.,* UXO/MEC detonations) sources, and, therefore, the 120 and 160 dB *re 1 μPa* (rms) thresholds are applicable.

Level A harassment—NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (*i.e.,* metric resulting in the largest isopleth). Ocean Wind's proposed activity includes the use of impulsive and non-impulsive sources.

These thresholds are provided in Table 5 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS' 2018 Technical Guidance, which may be accessed at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

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Table 5 -- Onset of Permanent Threshold Shift (PTS) (NMFS, 2018)

Hearing Group	PTS Onset Thresholds* (Received Level)	
	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{p,0\text{-}pk,flat}$: 219 dB $L_{E,p,\ LF,24h}$: 1183 dB	*Cell 2* $L_{E,p,\ LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{p,0\text{-}pk,flat}$: 230 dB $L_{E,p,\ MF,24h}$: 185 dB	*Cell 4* $L_{E,p,\ MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{p,0\text{-}pk,flat}$: 202 dB $L_{E,p,HF,24h}$: 155 dB	*Cell 6* $L_{E,p,\ HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{p,0\text{-}pk.flat}$: 218 dB $L_{E,p,PW,24h}$: 185 dB	*Cell 8* $L_{E,p,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{p,0\text{-}pk,flat}$: 232 dB $L_{E,p,OW,24h}$: 203 dB	*Cell 10* $L_{E,p,OW,24h}$: 219 dB

* Dual metric thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.

Note: Peak sound pressure level ($L_{p,0\text{-}pk}$) has a reference value of 1 µPa, and weighted cumulative sound exposure level ($L_{E,p}$) has a reference value of 1µPa^{2}s. In this Table, thresholds are abbreviated to be more reflective of International Organization for Standardization standards (ISO, 2017). The subscript "flat" is being included to indicate peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kHz). The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The weighted cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these thresholds will be exceeded.

Explosive sources—Based on the best available science, NMFS uses the acoustic and pressure thresholds indicated in Tables 6 and 7 to predict the onset of behavioral harassment, TTS, PTS, tissue damage, and mortality from explosive detonations.

Table 6 -- PTS onset, TTS onset, and behavioral thresholds (multiple detonations) for underwater explosives (NMFS, 2018)

Hearing Group	PTS Impulsive Thresholds	TTS Impulsive Thresholds	Behavioral Threshold (multiple detonations)
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{pk,flat}$: 213 dB $L_{E,LF,24h}$: 168 dB	*Cell 3* $L_{E,LF,24h}$: 163 dB
Mid-Frequency (MF) Cetaceans	*Cell 4* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 5* $L_{pk,flat}$: 224 dB $L_{E,MF,24h}$: 170 dB	*Cell 6* $L_{E,MF,24h}$: 165 dB
High-Frequency (HF) Cetaceans	*Cell 7* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 8* $L_{pk,flat}$: 196 dB $L_{E,HF,24h}$: 140 dB	*Cell 9* $L_{E,HF,24h}$: 135 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 10* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 11* $L_{pk,flat}$: 212 dB $L_{E,PW,24h}$: 170 dB	*Cell 12* $L_{E,PW,24h}$: 165 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 13* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 14* $L_{pk,flat}$: 226 dB $L_{E,OW,24h}$: 188 dB	*Cell 15* $L_{E,OW,24h}$: 183 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS/TTS onset.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI, 2013). However, ANSI defines peak sound pressure as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the overall marine mammal generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Additional thresholds for the onset of non-auditory injury to lung and gastrointestinal organs from the blast shock wave and/or high peak pressures are also relevant (at relatively close ranges) (Table 7). These criteria have been developed by the U.S. Navy (DoN (U.S. Department of the Navy), 2017a) and are based on the mass of the animal (*e.g.,* lowest to highest range for each hearing group) and the depth at which it is present in the water column. Equations predicting the onset of the associated potential effects are included below (Table 7).

Table 7 -- Lung and G.I. tract injury thresholds (DoN, 2017)

Hearing Group	Mortality (Severe lung injury)*	Slight Lung Injury*	G.I. Tract Injury
All Marine Mammals	*Cell 1* Modified Goertner model; *Equation 1*	*Cell 2* Modified Goertner model; *Equation 2*	*Cell 3* $L_{pk,flat}$: 237 dB

* Lung injury (severe and slight) thresholds are dependent on animal mass (Recommendation: Table C.9 from DoN (2017) based on adult and/or calf/pup mass by species).

Note: Peak sound pressure (L_{pk}) has a reference value of 1 µPa. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI, 2013). However, ANSI defines peak sound pressure as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the overall marine mammal generalized hearing range.

Modified Goertner Equations for severe and slight lung injury (pascal-second)

Equation 1: 103M1/3(1 + D/10.1)1/6 Pa-s

Equation 2: 47.5M1/3(1 + D/10.1)1/6 Pa-s

M animal (adult and/or calf/pup) mass (kg) (Table C.9 in DoN, 2017)

D animal depth (meters)

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Below, we discuss the acoustic modeling, marine mammal density information, and take estimation for each of Ocean Wind's proposed construction activities. NMFS has carefully considered all information and analysis presented by the applicant as well as all other applicable information and, based on the best available science, concurs that the applicant's estimates of the types and amounts of take for each species and stock are complete and accurate.

Marine Mammal Densities

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

Habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory and the Marine-life Data and Analysis Team, based on the best available marine mammal data from 1992–2022 obtained in a collaboration between Duke University, the Northeast Regional Planning Body, the University of North Carolina Wilmington, the Virginia Aquarium and Marine Science Center, and NOAA (Roberts *et al.,* 2016a, 2016b, 2017, 2018, 2020, 2021a, 2021b; Roberts and Halpin, 2022), represent the best available information regarding marine mammal densities in the survey area. More recently, these data have been updated with new modeling results and include density estimates for pinnipeds (Roberts *et al.,* 2016b, 2017, 2018; Roberts and Halpin, 2022). Density data are subdivided into five separate raster data layers for each species, including: Abundance (density), 95 percent-Confidence Interval of Abundance, 5 percent Confidence Interval of Abundance, Standard Error of Abundance, and Coefficient of Variation of Abundance.

Ocean Wind's initial densities and take estimates were included in the ITA application that was considered Adequate & Complete on February 11, 2022, in line with NMFS' standard ITA guidance (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/apply-incidental-take-authorization*). However, on June 20, 2022, the Duke Marine Geospatial Ecology Laboratory released a new, and more comprehensive, set of marine mammal density models for the area along the East Coast of the United States (Roberts and Halpin, 2022). The differences between the new density data and the older data necessitated the use of updated marine mammal densities and, subsequently, revised marine mammal take estimates. This information was provided to NMFS as a memo (referred to as the Revised Density and Take Estimate Memo) on August 29, 2022 after continued discussion between Ocean Wind and NMFS and NMFS has considered it in this analysis. The Revised Density and Take Estimate Memo was made public on NMFS' website (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility*).

The densities used to estimate take from foundation installation, were calculated based on average monthly densities for all grid cells within the lease area as well as grid cells extending an additional 5 km (3.11 mi) beyond the lease area, referred to as a 5 km perimeter (refer to Figure 1 of the Revised Density and Take Estimate Memo provided by Orsted and found on NMFS' website). The take estimates assumed that up to 60 WTG monopiles would be installed in the highest density month for each marine mammal species (2 monopiles per day maximum × 30 days) with the remaining 38 WTG monopiles being installed in the second highest density month (2 monopiles per day maximum × 19 days). This estimation approach is conservative as it is unlikely that all piles will be installed within 2 months; however, given the uncertainty with the exact pile schedule, this approach allows for the worst-case scenario to be analyzed and provides certainty that the maximum of take has been analyzed. Although Ocean Wind is not sure which foundation type would be used for the OSSs (monopiles or jackets), the highest month density was used for the exposure modeling of pin piles using jacket foundations as this resulted in the highest number of takes as was considered reasonable that all 48 pin piles could be installed in a single month (3 pin piles per day × 16 days).

For cofferdam density estimates, a 10 km (6.21 mi) perimeter was applied around each of the cofferdam locations (Figure 2 of the Revised Density and Take Estimate Memo), with densities averaged among the seven cofferdam locations to result in one density table for all cofferdams. Due to the uncertainty of the specific months that temporary cofferdams would be installed and removed via vibratory pile driving, Ocean Wind used the average density for the months of October through May, as described in the Revised Density and Take Estimate Memo. We note that in the application Ocean Wind assumed all the work would occur in the month when a species density was the highest (*e.g.,* Ocean Wind has assumed all cofferdam would occur in December for humpback whales but in April for sei whales; Table 6–2 in the ITA application). This original approach was deemed too conservative and the revised approach, as described in the aforementioned Memo, avoids the unnecessary overestimation of marine mammal takes. While it is possible for seven 4-day installation/removal events to occur within the same month, there is no specific expectation that the installations will occur immediately one after another across the different locations and, therefore, this approach is appropriate.

To estimate densities for the HRG surveys occurring both within the lease area and within the export cable routes, a 5 km (3.11 mi) perimeter was applied around the cable corridors (Figure 3 of the Revised Density and Take Estimate Memo). Given this work could occur year-round, the average annual density for each species was calculated using average monthly densities from January through December. The revised density estimates for HRG surveys were calculated for both the export cable route area and the lease area in the Revised Density and Take Estimate Memo in a way that aligned with the proposed schedule for HRG activities (88 survey days in Years 1, 4, and 4; 180 survey days in Years 2 and 3), as opposed to averaging the each species annual density across the entire project area was presented in the ITA application. Furthermore, while the original ITA application included the entire HRG area (Lease Area and export cable routes) collectively, the Memo has separated these two locations with more specific densities for the export cable route and Lease Area. These changes better account for the activity footprint and perimeter (5 km) to more accurately represent the spatial extent and resolution of the survey effort planned.

For UXO/MEC detonations, given that UXOs/MECs have the potential to occur anywhere within the project area, a 15 km (9.32 mi) perimeter was applied to both the lease area and the export cable corridors (Figure 4 of the Revised Density and Take Estimate Memo). In cases where monthly densities were unavailable, annual densities were used instead (*i.e.,* blue whales, pilot whale *spp.,* Atlantic spotted dolphins).

NMFS notes several exceptions to the determination of the relevant densities for some marine mammal species to the method described above. These are described here in greater detail.

For several marine mammal species, the Roberts data does not differentiate by stock. This is true for the bottlenose dolphins, for which two stocks were requested to be taken by Ocean Wind (coastal migratory and offshore stock). This is also true for long-finned and short-finned pilot whales (pilot whales *spp.*) and harbor and gray seals (seals), where a pooled density is the only value available from the data that is not partitioned by stock. To account for this, the coastal migratory and offshore stocks of bottlenose dolphins were adjusted based on the 20-m isobath cutoff, such that take predicted to occur in any area less than 20-m in depth was apportioned to the coastal stock only and take predicted to occur in waters of greater than 20 m of depth was apportioned to the offshore stock. The densities for the pilot whales were apportioned based on their relative abundance in the project area to estimate species- and stock-specific exposures. The same approach was taken for the two pinniped species (harbor and gray seals), where each species was scaled based on its relative abundance in the project area, as opposed the application of the same density to both, as previously described in the ITA application. Table 8, 9, 10, and 11 below demonstrate all of the densities used in the exposure and take analyses.

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Table 8 -- The Highest and Second Highest Monthly Marine Mammal And Annual Densities (Animals Per Km^2) Used For The Modeling Of Ocean Wind's WTGs And OSSs From May Through December

Marine Mammal Species	Monopile Foundations		Jacket Foundations
	First Highest Density	Second Highest Density	First Highest Density
North Atlantic right whale [a]	0.00045 (December)	0.00012 (November)	0.00045 (December)

Blue whale [a]	– [c]	– [c]	– [c]
Fin whale [a]	0.00141 (December)	0.00080 (May)	0.00141 (December)
Sei whale [a]	0.00042 (December)	0.00021 (November)	0.00042 (December)
Minke whale	0.00674 (May)	0.00154 (June)	0.00674 (May)
Humpback whale	0.00126 (December)	0.00085 (May)	0.00126 (December)
Sperm whale [a]	0.00008 (May)	0.00004 (December)	0.00008 (May)
Atlantic white-sided dolphin	0.00643 (May)	0.00539 (November)	0.00643 (May)
Atlantic spotted dolphin	– [c]	– [c]	– [c]
Bottlenose dolphin (offshore stock) [b]	0.11352 (August)	0.11146 (November)	0.11352 (August)
Bottlenose dolphin (coastal stock) [b]	0.51100 (September)	0.47620 (August)	0.51100 (September)
Short-finned pilot whale [b]	0.00011 (annual)	n/a	0.00011 (annual)
Long-finned pilot whale [b]	0.00015 (annual)	n/a	0.00015 (annual)
Risso's dolphin	0.00096 (December)	0.00063 (November)	0.00096 (December)
Common dolphin	0.05157 (December)	0.04682 (November)	0.05157 (December)
Harbor porpoise	0.02456 (December)	0.00801 (May)	0.02456 (December)
Harbor seal	0.09830 (December)	0.08433 (May)	0.09830 (December)
Gray seal	0.03517 (December)	0.03017 (May)	0.03517 (December)

a – Listed as Endangered under the Endangered Species Act.
b – Densities were adjusted by their relative abundance.
c – Exposure modeling for the blue whale and Atlantic spotted dolphin was not conducted because impacts to those species approach zero due to their low predicted densities in the Project; therefore, were excluded from all quantitative analyses and tables based on modeling results.

Table 9 -- The Marine Mammal Average And Annual Densities (Animals Per Km^2) Used For Analysis Of Ocean Wind's Cofferdam Installation And Removal For October Through May

Marine Mammal Species	Period of Density Used	Estimated Density
North Atlantic right whale [a]	October - May average	0.00028
Blue whale [a]	Annual Density	0.00075
Fin whale [a]	October - May average	0.00039
Sei whale [a]	October - May average	0.00014
Minke whale	October - May average	0.00078
Humpback whale	October - May average	0.00062
Sperm whale [a]	October - May average	0.00002
Atlantic white-sided dolphin	October - May average	0.00077
Bottlenose dolphin (offshore stock) [b]	October - May average	0.14866
Bottlenose dolphin (coastal stock) [b]	October - May average	0.32471
Short-finned pilot whale [b]	Annual Density	0.00001
Long-finned pilot whale [b]	Annual Density	0.00001
Risso's dolphin	October - May average	0.00002
Common dolphin	October - May average	0.00409
Harbor porpoise	October - May average	0.00854
Harbor seal	October - May average	0.10069
Gray seal	October - May average	0.03602

a – Listed as Endangered under the Endangered Species Act.

b – Densities were adjusted by their relative abundance (short-finned pilot whale = 0.00000133395 animals/km^2; long-finned pilot whale = 0.00000181 animals/km^2).

Table 10 -- The Highest Monthly Marine Mammal and Annual Densities (Animals Per Km^2) Used For The Modeling of Ocean Wind's UXOs/MECs For May Through October

Marine Mammal Species	Density Used
North Atlantic right whale [a]	0.00008 (May)
Blue whale [a]	0.00001 (Annual)
Fin whale [a]	0.00068 (May)
Sei whale [a]	0.00021 (May)
Minke whale	0.00627 (May)
Humpback whale	0.00081 (May)
Sperm whale [a]	0.00008 (May)
Atlantic white-sided dolphin	0.00545 (May)
Bottlenose dolphin (offshore stock) [b]	0.12615 (August)
Bottlenose dolphin (coastal stock) [b]	0.71100 (September)
Short-finned pilot whale [b]	0.00010 (Annual)
Long-finned pilot whale [b]	0.00013 (Annual)
Risso's dolphin	0.00021 (May)
Common dolphin	0.02407 (May)
Harbor porpoise	0.00789 (May)
Harbor seal	0.09467 (May)
Gray seal	0.03387 (May)

a – Listed as Endangered under the Endangered Species Act.
b – Densities were adjusted by their relative abundance.

Table 11 -- The Highest Monthly Marine Mammal, Average, and Annual Densities In (Animals Per Km²) Used For Analysis of Ocean Wind's HRG Survey Effort For The Export Cable Route and Inter-Array Cables From January Through December

Marine Mammal Species	Wind Farm Area	Export Cable Route
North Atlantic right whale [a]	0.00026 (Average Annual)	0.00026 (Average Annual)
Blue whale [a]	0.00001 (Annual)	0.00001 (Annual)
Fin whale [a]	0.00086 (Average Annual)	0.00054 (Average Annual)
Sei whale [a]	0.00022 (Average Annual)	0.00016 (Average Annual)
Minke whale	0.00171 (Average Annual)	0.00099 (Average Annual)
Humpback whale	0.00069 (Average Annual)	0.00057 (Average Annual)
Sperm whale [a]	0.00003 (Average Annual)	0.00002 (Average Annual)
Atlantic white-sided dolphin	0.00399 (Average Annual)	0.00130 (Average Annual)
Bottlenose dolphin (offshore stock) [b]	0.06119 (Average Annual)	0.14499 (Average Annual)
Bottlenose dolphin (coastal stock) [b]	0.18073 (Average Annual)	0.36680 (Average Annual)
Short-finned pilot whale [b]	0.00014 (Annual)	0.00001 (Annual)
Long-finned pilot whale [b]	0.00018 (Annual)	0.00002 (Annual)
Risso's dolphin	0.00029 (Average Annual)	0.00005 (Average Annual)
Common dolphin	0.02418 (Average Annual)	0.00702 (Average Annual)
Harbor porpoise	0.01518 (Average Annual)	0.00925 (Average Annual)
Harbor seal	0.04715 (Average Annual)	0.06051 (Average Annual)
Gray seal	0.01687 (Average Annual)	0.02165 (Average Annual)

a – Listed as Endangered under the Endangered Species Act.
b – Densities were adjusted by their relative abundance.

Modeling and Take Estimation

Below, we describe the three methods that were used to estimate take in consideration of the acoustic thresholds and marine mammal densities described above and the four different activities (WTG and OSS foundation installation, temporary cofferdam installation/removal, UXO/MEC detonation, and HRG surveys). The take estimates for the four different activities, as well as the combined total, are presented.

WTG and OSS Foundation Installation (Impact Pile Driving) Take Estimates

As described above, Ocean Wind has proposed to install up to 98 WTGs and 3 OSS in the project area. Ocean Wind has proposed two piling scenarios that may be encountered during the construction of the OSSs and were therefore considered in the acoustic modeling conducted to estimate the potential number of marine mammal exposures above relevant harassment thresholds: (1) all monopile build-out for WTGs and OSS (101 monopiles total), and (2) a joint-monopile WTG and OSS jacket foundation build-out (98 monopiles and 48 pin piles total). Full installation parameters for each of the monopile and jacket foundations are described below:

(1) Monopile foundation (for either WTG only or WTG and OSS) with either 98 (assuming OSSs are built-out using jacket foundations) or 101 8/11 m diameter tapered piles (assuming both WTG and OSS are using monopile foundations; one monopile per WTG/OSS); and/or,

(2) Jacket foundations (for OSS only) with up to 48 2.44 m diameter pin piles total (16 per OSS).

In recognition of the need to ensure that the range of potential impacts to marine mammals from the various potential scenarios are accounted for, both piling scenarios (WTG using monopiles; OSS using monopiles or jacket foundations with pin piles) were modeled separately in order to assess the impacts of each. The two impact pile driving installation scenarios modeled are:

(1) Full monopile foundation scenario (see Table 1–7 in the Ocean Wind 1 ITA application): A total of 10,846 hammer strikes are needed per pile over 4 hours (392 total hours needed for 98 WTGs or 404 total hours needed for 101 WTGS and OSS foundations (12 hours total specific to OSS installation)); and,

(2) A joint-monopile and jacket foundation scenario (see Table 1–15 in the Ocean Wind 1 ITA application): A total of 13,191 hammer strikes are needed per pile over 4 hours (192 hours are necessary to complete the installation of all pin piles).

Representative hammering schedules of increasing hammer energy with increasing penetration depth were modeled, resulting in, generally, higher intensity sound fields as the hammer energy and penetration increases (Table 12).

Table 12 -- Estimated Impact Hammer Energy Schedules For Monopiles and Pin Piles

Monopile foundations (8/11-m)			Jacket Foundations (Pin piles; 2.44-m)		
Hammer: IHC S-4000			Hammer: IHC S-2500		
Energy Level (kJ)[1]	Strike Count	Pile Penetration Depth (m)	Energy Level (kJ)	Strike Count	Pile Penetration Depth
500	763	7	500	554	3
2,000	980	6	200	5,373	29
1,000	375	3	750	1,402	8
3,000	385	2	1,000	1,604	8
4,000	5,006	16	1,500	1,310	6
3,000	1,135	6	2,500	1,026	6
4,000	2,202	10	1,500	1,922	10
Total:	10,846	50	Total:	13,191	70

1 – Sediment types with greater resistances require hammers that deliver higher energy strikes and/or an increased number of strikes relative to installation in softer sediments. Typically the maximum sound levels usually occur during the last stage of impact pile installation where the greatest resistance is encountered (Betke, 2008).

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Both monopiles and pin piles were assumed to be vertically aligned and driven to a maximum depth of 50 m for monopiles and 70 m for pin piles. While pile penetration depths may vary slightly, these values were chosen as reasonable penetration depths during modeling. All acoustic modeling was performed assuming that concurrent pile driving of either monopiles or pin piles would not occur. While multiple piles may be driven within any single 24-hour period, these installation activities would not occur simultaneously. Below we describe the assumptions inherent to the modeling approach and those by which Ocean Wind 1 would not exceed:

Modeling assumptions for the project are as follows:

• Two monopiles installed per day (4 hours per monopile with a 1 hour pre-clearance period; 9 hours of total with 8 hours of active pile driving time), although only one monopile may be installed on some days;
• No concurrent monopile and/or pin pile driving would occur;
• Monopiles would be 80 millimeters (mm) thick and consist of steel;
• Impact Pile driving: IHC S–4000 or IHC S–2500 kJ rated energy; 1,977.151 kilonewton (kN) ram weight);
• Helmet weight: 3,776.9 kN;
• Impact hammers would have a maximum power capacity of 6,000 kilowatts (KW);
• Up to three pin piles installed per day;
• Pin piles would be 75 mm thick;
• Impact Pile driving: IHC S–2,500 kJ rated energy; 1,227.32 kN ram weight);
• Helmet weight: 279 kN.

Sound fields produced during impact pile driving were modeled by first characterizing the sound signal produced during pile driving using the industry standard GRLWEAP (wave equation analysis of pile driving) model and JASCO Applied Sciences' (JASCO) Pile Driving Source Model (PDSM). We provide a summary of the modelling effort below but the full JASCO modeling report can be found in Section 6 and Appendix A of Ocean Wind's ITA application (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility*).

Underwater sound propagation (*i.e.,* transmission loss) as a function of range from each source was modeled using JASCO's Marine Operations Noise Model (MONM) for multiple propagation radials centered at the source to yield 3D transmission loss fields in the surrounding area. The MONM computes received per-pulse SEL for directional sources at specified depths. MONM uses two separate models to estimate transmission loss.

At frequencies less than 2 kHz, MONM computes acoustic propagation via a wide-angle parabolic equation (PE) solution to the acoustic wave equation based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM) modified to account for an elastic seabed. MONM–RAM incorporates bathymetry, underwater sound speed as a function of depth, and a geo-acoustic profile based on seafloor composition, and accounts for source horizontal directivity. The PE method has been extensively benchmarked and is widely employed in the underwater acoustics community, and MONM–RAM's predictions have been validated against experimental data in several underwater acoustic measurement programs conducted by JASCO. At frequencies greater than 2 kHz, MONM accounts for increased sound attenuation due to volume absorption at higher frequencies with the widely used BELLHOP Gaussian beam ray-trace propagation model. This component incorporates bathymetry and underwater sound speed as a function of depth with a simplified representation of the sea bottom, as sub-bottom layers have a negligible influence on the propagation of acoustic waves with frequencies above 1 kHz. MONM–BELLHOP accounts for horizontal directivity of the source and vertical variation of the source beam pattern. Both propagation models account for full exposure from a direct acoustic wave, as well as exposure from acoustic wave reflections and refractions (*i.e.,* multi-path arrivals at the receiver).

The sound field radiating from the pile was simulated using a vertical array of point sources. Because sound itself is an oscillation (vibration) of water particles, acoustic modeling of sound in the water column is inherently an evaluation of vibration. For this study, synthetic pressure waveforms were computed using the full-wave range-dependent acoustic model (FWRAM), which is JASCO's acoustic propagation model capable of producing time-domain waveforms.

Models are more efficient at estimating SEL than SPL_{rms}. Therefore, conversions may be necessary to derive the corresponding SPL_{rms}. Propagation was modeled for a subset of sites using the FWRAM, from which broadband SEL to SPL conversion factors were calculated. The FWRAM required intensive calculation for each site, thus a representative subset of modeling sites were used to develop azimuth-, range-, and depth-dependent conversion factors. These conversion factors were used to calculate the broadband SPL_{rms} from the broadband SEL prediction.

The sound fields for the monopile and pin pile scenarios were each modeled based on one representative location in the project area. For monopiles this area is G10 and for jacket foundations with pin piles this area is Z11 (see in Appendix A of the ITA application). Both modeling locations were selected as they were determined to be the most representative of the water depths in the Ocean Wind 1 project area, as appropriate for each foundation type (*i.e.,* monopiles in shallower waters and jackets in deeper waters). All monopiles were assumed to be driven vertically and to a maximum penetration depth of 50 m (164 ft). All pin piles associated with jacket foundations were also assumed to be driven vertically to a maximum penetration depth of 70 m (230 ft).

The model also incorporated two different sound velocity profiles (related to in situ measurements of temperature, salinity, and pressure within the water column) to account for variations in the acoustic propagation conditions between summer (May through November) and winter (December only). Estimated pile driving schedules (Table 12) were used to calculate the SEL sound fields at different points in time during impact pile driving.

Next, Ocean Wind modeled the sound field produced during impact pile driving by incorporating the results of the source level modeling into an acoustic propagation model. The sound propagation model incorporated site-specific environmental data that considers bathymetry, sound speed in the water column, and seabed geo-acoustics in the construction area.

Ocean Wind estimated both acoustic ranges and exposure ranges. Acoustic ranges represent the distance to a harassment threshold based on sound propagation through the environment (*i.e.,* independent of any receiver) while exposure range represents the distance at which an animal can accumulate enough energy to exceed a Level A harassment threshold in consideration of how it moves through the environment (*i.e.,* using movement modeling). In both cases, the sound level estimates are calculated from three-dimensional sound fields and then, at each horizontal sampling range, the maximum received level that occurs within the water column is used as the received level at that range. These maximum-over-depth (R_{max}) values are then compared to predetermined threshold levels to determine acoustic and exposure ranges to Level A harassment and Level B harassment zone isopleths. However, the ranges to a threshold typically differ among radii from a source, and also might not be continuous along a radii because sound levels may drop below threshold at some ranges and then exceed threshold at farther ranges. To minimize the influence of these inconsistencies, 5 percent of the farthest such footprints were excluded from the model data. The resulting range, $R_{95\%}$, was chosen to identify the area over which marine mammals may be exposed above a given threshold, because, regardless of the shape of the maximum-over-depth footprint, the predicted range encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified threshold. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the heterogeneity of the acoustic environment. $R_{95\%}$ excludes ends of protruding areas or small isolated acoustic foci not representative of the nominal ensonified zone. For purposes of calculating Level A harassment take, Ocean Wind applied $R_{95\%}$ exposure ranges, not acoustic ranges, to estimate take and determine mitigation distances for the reasons described below.

In order to best evaluate the (SEL_{cum}) harassment thresholds for PTS, it is necessary to consider animal movement, as the results are based on how sound moves through the environment between the source and the receiver. Applying animal movement and behavior within the modeled noise fields provides the exposure range, which allows for a more realistic indication of the distances at which PTS acoustic thresholds are reached that considers the accumulation of sound over different durations (note that in all cases the distance to the peak threshold is less than the SEL-based threshold).

As described in Section 2.6 of Appendix A of Ocean Wind's ITA application, for modeled animals that have received enough acoustic energy to exceed a given Level A harassment threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. The resulting exposure range for each species is the 95th percentile of the CPA distances for all animals that exceeded threshold levels for that species (termed the 95 percent exposure range ($ER_{95\%}$)). The $ER_{95\%}$ ranges are species-specific rather than categorized only by any functional hearing group, which allows for the incorporation of more species-specific biological parameters (*e.g.,* dive durations, swim speeds, *etc.*) for assessing the impact ranges into the model. Furthermore, because these $ER_{95\%}$ ranges are species-specific, they can be used to develop mitigation monitoring or shutdown zones.

Tables 13 and 14 below represent the $ER_{95\%}$ exposure ranges (for SEL_{cum} and SPL_{rms}) for monopiles foundations, with Table 13 demonstrating the ranges using the summer sound speed profile and Table 14 using the winter sound speed profile. For both tables, a single monopiles and two monopiles per day are provided (the two per day ranges are shown in the parenthesis). NMFS notes that monopiles foundations constructed for Ocean Wind 1 are applicable to all WTGs and may be applicable to OSS structures, depending on the finalized buildout. Please see the Estimated Take section below, Appendix A of the Ocean Wind 1 ITA application, and Appendix R of the Ocean Wind 1 COP for further details on the acoustic modeling methodology.

Displayed in Tables 13, 14, 15, and 16 below, Ocean Wind would also employ a noise abatement system during all impact pile driving of monopiles and pin piles. Noise abatement systems, such as bubble curtains, are sometimes used to decrease the sound levels radiated from a source. Additional information on sound attenuation devices is discussed in the Noise Abatement Systems section under Proposed Mitigation. In modeling the sound fields for Ocean Wind's proposed activities, hypothetical broadband attenuation levels of 0 dB, 6 dB, 10 dB, 15 dB, and 20 dB were modeled to gauge the effects on the ranges to thresholds given these levels of attenuation. The results for 10 dB of sound attenuation are shown below and the other attenuation levels (0 dB, 6 dB, 15 dB, and 20 dB) can be found in the ITA application.

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Table 13 - Level A Harassment (SEL_{cum}) and Level B Harassment (SPL_{rms}) Exposure Ranges ($ER_{95\%}$) In Kilometers for Monopile Foundations in the Summer (May - November); Exposures for One (Two) Monopiles per Day Are Shown

Marine Mammal Species	Ranges to Threshold (Assuming 10 dB attenuation)	
	Level A Harassment	Level B Harassment
Fin whale	1.58 (1.65)	3.04 (3.13)
Minke whale	1.23 (1.26)	3.13 (3.10)
Humpback whale	1.14 (1.05)	3.10 (3.09)
North Atlantic right whale	1.28 (1.37)	2.95 (2.98)
Sei whale	1.36 (1.27)	3.13 (3.09)
Blue whale*	- (-)	- (-)
Atlantic white-sided dolphin	0 (0)	3.10 (3.04)
Atlantic spotted dolphin*	- (-)	- (-)
Common dolphin	0 (0)	3.09 (3.05)
Bottlenose dolphin (coastal stock)	0 (0)	2.80 (2.81)
Bottlenose dolphin (offshore stock)	0 (0)	2.90 (2.81)
Risso's dolphin	0 (0)	3.06 (3.09)
Long-finned pilot whale	0 (0)	0 (0)
Short-finned pilot whale	0 (0)	3.01 (3.08)
Sperm whale	0 (0)	0 (0)
Harbor porpoise	0.84 (0.88)	3.11 (3.07)
Gray seal	0 (0.08)	3.21 (3.09)
Harbor seal	0 (0.06)	3.11 (3.08)

* Exposure modeling for the blue whale and Atlantic spotted dolphin was not conducted because impacts on the species approach zero due to their low predicted densities in the project area. These species were excluded from quantitative analyses and tables. Results for these scenarios can be found in Appendix A found in the ITA application.

Table 14 -- Level A Harassment (SEL_{cum}) and Level B Harassment (SPL_{rms}) Exposure Ranges ($ER_{95\%}$) In Kilometers for Monopile Foundations in the Winter (December); Exposures for One (Two) Monopiles per Day Are Shown

Marine Mammal Species	Ranges to Threshold (Assuming 10 dB attenuation)	
	Level A Harassment	Level B Harassment
Fin whale	2.33 (2.49)	3.48 (3.44)
Minke whale (migrating)	1.98 (1.98)	3.39 (3.42)
Humpback whale (migrating)	1.75 (1.77)	3.32 (3.37)
North Atlantic right whale (migrating)	1.85 (2.03)	3.28 (3.35)
Sei whale (migrating)	1.86 (2.19)	3.42 (3.45)
Blue whale*	- (-)	- (-)
Atlantic white-sided dolphin	0 (0)	3.37 (3.33)
Atlantic spotted dolphin*	- (-)	- (-)
Common dolphin	0 (0)	3.40 (3.36)
Bottlenose dolphin (coastal stock)	0 (0)	3.12 (3.15)
Bottlenose dolphin (offshore stock)	0 (0)	3.22 (3.18)
Risso's dolphin	0 (0)	3.49 (3.36)
Long-finned pilot whale	0 (0)	0 (0)
Short-finned pilot whale	0 (0)	3.31 (3.41)
Sperm whale	0 (0)	0 (0)
Harbor porpoise	1.06 (1.43)	3.34 (3.37)
Gray seal	0 (0.14)	3.44 (3.42)
Harbor seal	0.07 (0.24)	3.47 (3.31)

* Exposure modeling for the blue whale and Atlantic spotted dolphin was not conducted because impacts on the species approach zero due to their low predicted densities in the project area. These species were excluded from quantitative analyses and tables. Results for these scenarios can be found in Appendix A found in the ITA application.

Tables 15 and 16 below represent the exposure ranges ($ER_{95\%}$) for jacket foundations, with Table 15 demonstrating the ranges using the summer sound speed profile and Table 16 using the winter sound speed profile.

For both tables, two pin piles and three pin piles (the three pin pile ranges are shown in the parenthesis) per day are provided. NMFS notes that jacket foundations used in Ocean Wind 1 are applicable only to OSS structures, depending on the finalized buildout. As with Tables 13 and 14 above, sound reductions of 0, 6, 10, 15, and 20 dB were modeled, but Ocean Wind would only be required to meet a minimum sound reduction level of 10 dB. The results for 10 dB of sound attenuation are shown below and the other attenuation levels (0 dB, 6 dB, 15 dB, and 20 dB) can be found in the ITA application.

Table 15 -- Level A (SEL_{cum}) and Level B Harassment (SPL_{rms}) Exposure Ranges ($ER_{95\%}$) In Kilometers for Jacket Foundations (Pin Piles) in the Summer; Exposure Distances For Two (Three) Pin Piles per Day Are Shown

Marine Mammal Species	Ranges to Threshold (Assuming 10 dB attenuation)	
	Level A Harassment	Level B Harassment
Fin whale	0.55 (0.59)	1.82 (1.79)
Minke whale	0.55 (0.51)	1.76 (1.76)
Humpback whale	0.40 (0.42)	1.81 (1.86)
North Atlantic right whale	0.51 (0.58)	1.64 (1.72)
Sei whale	0.37 (0.36)	1.81 (1.84)
Blue whale*	- (-)	- (-)
Atlantic white-sided dolphin	0 (0)	1.55 (1.72)
Atlantic spotted dolphin*	- (-)	- (-)
Common dolphin	0 (0)	1.72 (1.72)
Bottlenose dolphin (coastal stock)	0 (0)	1.53 (1.46)
Bottlenose dolphin (offshore stock)	0 (0)	1.58 (1.60)
Risso's dolphin	0 (0)	1.61 (1.65)
Long-finned pilot whale	0 (0)	0 (0)
Short-finned pilot whale	0 (0)	0 (0)
Sperm whale	0 (0)	0 (0)
Harbor porpoise	0.61 (0.61)	1.75 (1.73)
Gray seal	0 (less than 0.01)	1.75 (1.65)
Harbor seal	0 (less than 0.01)	1.96 (1.91)

* Exposure modeling for the blue whale and Atlantic spotted dolphin was not conducted because impacts on the species approach zero due to their low predicted densities in the project area. These species were excluded from quantitative analyses and tables. Results for these scenarios can be found in Appendix A found in the ITA application.

Table 16 -- Level A (SEL_{cum}) and Level B Harassment (SPL_{rms}) Exposure Ranges ($ER_{95\%}$) In Kilometers for Jacket Foundations (Pin Piles) in the Winter; Exposure Distances For Two (Three) Pin Piles per Day Are Shown

Marine Mammal Species	Ranges to Threshold (Assuming 10 dB attenuation)	
	Level A Harassment	Level B Harassment
Fin whale	0.84 (0.74)	2.11 (2.04)
Minke whale	0.58 (0.59)	2.09 (2.06)
Humpback whale	0.52 (0.51)	2.18 (2.11)
North Atlantic right whale	0.69 (0.70)	2.06 (2.11)
Sei whale	0.59 (0.53)	2.13 (2.03)
Blue whale*	- (-)	- (-)
Atlantic white-sided dolphin	0 (0)	2.12 (2.08)
Atlantic spotted dolphin*	- (-)	- (-)
Common dolphin	0 (0)	2.09 (2.06)
Bottlenose dolphin (coastal stock)	0 (0)	1.97 (1.88)
Bottlenose dolphin (offshore stock)	0 (0)	1.91 (1.85)
Risso's dolphin	0 (0)	1.93 (1.87)
Long-finned pilot whale	0 (0)	0 (0)
Short-finned pilot whale	0 (0)	0 (0)
Sperm whale	0 (0)	0 (0)
Harbor porpoise	0.63 (0.70)	2.16 (2.06)
Gray seal	0 (less than 0.01)	2.33 (2.14)
Harbor seal	0 (less than 0.01)	2.24 (2.19)

* Exposure modeling for the blue whale and Atlantic spotted dolphin was not conducted because impacts on the species approach zero due to their low predicted densities in the project area. These species were excluded from quantitative analyses and tables. Results for these scenarios can be found in Appendix A found in the ITA application.

JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) animal movement model was used to predict the number of marine mammals exposed to impact pile driving sound above NMFS' injury and behavioral harassment thresholds. Sound exposure models like JASMINE use simulated animals (also known as ''animats'') to forecast behaviors of animals in new situations and locations based on previously documented behaviors of those animals. The predicted 3D sound fields (*i.e.,* the output of the acoustic modeling process described earlier) are sampled by animats using movement rules derived from animal observations. The output of the simulation is the exposure history for each animat within the simulation.

The precise location of animats (and their pathways) are not known prior to a project, therefore a repeated random sampling technique (Monte Carlo) is used to estimate exposure probability with many animats and randomized starting positions. The probability of an animat starting out in or transitioning into a given behavioral state can be defined in terms of the animat's current behavioral state, depth, and the time of day. In addition, each travel parameter and behavioral state has a termination function that governs how long the parameter value or overall behavioral state persists in the simulation.

The output of the simulation is the exposure history for each animat within the simulation, and the combined history of all animats gives a probability density function of exposure during the project. Scaling the probability density function by the real-world density of animals results in the mean number of animats expected to be exposed to a given threshold over the duration of the project. Due to the probabilistic nature of the process, fractions of animats may be predicted to exceed threshold. If, for example, 0.1 animats are predicted to exceed threshold in the model, that is interpreted as a 10 percent chance that one animat will exceed a relevant threshold during the project, or equivalently, if the simulation were re-run 10 times, 1 of the 10 simulations would result in an animat exceeding the threshold. Similarly, a mean number prediction of 33.11 animats can be interpreted as re-running the simulation where the number of animats exceeding the threshold may differ in each simulation but the mean number of animats over all of the simulations is 33.11. A portion of an individual marine mammal cannot be taken during a project, so it is common practice to round mean number animat exposure values to integers using standard rounding methods. However, for low-probability events it is more precise to provide the actual values.

Sound fields were input into the JASMINE model, as described above, and animats were programmed based on the best available information to ''behave'' in ways that reflect the behaviors of the 17 marine mammal species (18 stocks) expected to occur in the project area during the proposed activity. The various parameters for forecasting realistic marine mammal behaviors (*e.g.,* diving, foraging, surface times, *etc.*) are determined based on the available literature (*e.g.,* tagging studies); when literature on these behaviors was not available for a particular species, it was extrapolated from a similar species for which behaviors would be expected to be similar to the species of interest. The parameters used in JASMINE describe animat movement in both the vertical and horizontal planes (*e.g.,* direction, travel rate, ascent and descent rates, depth, bottom following, reversals, inter-dive surface interval).

Animats were modeled to move throughout the three-dimensional sound fields produced by each construction schedule for the entire construction period. For PTS exposures, both SPL_{pk} and SEL_{cum} were calculated for each species based on the corresponding acoustic criteria. Once an animat is taken within a 24-hrs period, the model does not allow it to be taken a second time in that same period, but rather resets the 24-hrs period on a sliding scale across 7 days of exposure. Specifically, an individual animat's accumulated energy levels (SEL_{cum}) are summed over that 24-hrs period to determine its total received energy, and then compared to the PTS threshold. Takes by behavioral harassment are predicted when an animat enters an area ensonified by sound levels exceeding the associated behavioral harassment threshold.

It is important to note that the calculated or predicted takes represent a take instance or event within one day and likely overestimate the number of individuals taken for some species. Specifically, as the 24-hr evaluation window means that individuals exposed on multiple days are counted as multiple takes. For example, 10 takes may represent 10 takes of 10 different individual marine mammals occurring within 1 day each, or it may represent take of 1 individual on 10 different days; information about the species' daily and seasonal movement patterns helps to inform the interpretation of these take estimates. Also note that animal aversion was not incorporated into the JASMINE model runs that were the basis for the take estimate for any species.

To conservatively estimate the number of animals likely to be exposed above thresholds, 60 WTG monopiles (at a rate of 2 per day for 30 days) were assumed to be installed during the highest density month of each species. Additionally, 38 WTG monopiles (at a rate of 2 per day for 19 days) were also assumed to be installed during the month with the second highest species density. Two scenarios were considered for the three OSS foundations: either three monopiles (at a rate of two per day for 1 day and then 1 on a third day) or 48 pin piles (at a rate of three per day for a total of 16 days). The preliminary construction schedule is shown below in Table 17.

Table 17 -- Construction Schedule Assumptions for Both WTG and OSS Foundations

Foundation Type	Configuration	Days of Impact Pile Driving	
		1st Highest Density Month	2nd Highest Density Month
WTG	Monopile foundation, 2 piles per day	30	19
OSS, Scenario 1	Monopile foundation, 2 piles per day	1	-
	Monopile foundation, 1 pile per day	-	1
OSS, Scenario 2	Jacket foundation, 3 pin piles per day	16	0

Note: - indicate no piling days.

In summary, exposures were estimated in the following way:

(1) The characteristics of the sound output from the proposed pile driving activities were modeled using the GRLWEAP (wave equation analysis of pile driving) model and JASCO's PDSM;

(2) Acoustic propagation modeling was performed within the exposure model framework using JASCO's MONM and FWRAM that combined the outputs of the source model with the spatial and temporal environmental context (*e.g.,* location, oceanographic conditions, seabed type) to estimate sound fields;

(3) Animal movement modeling integrated the estimated sound fields with species-typical behavioral parameters in the JASMINE model to estimate received sound levels for the animals that may occur in the operational area; and

(4) The number of potential exposures above Level A and Level B harassment thresholds were calculated.

The results of marine mammal exposure modeling for the full monopile scenario (WTG and OSS) and joint foundation approach (WTGs use monopiles; OSSs use jackets with pin piles) over 5 years assuming 10 dB attenuation only are shown in Tables 18 and 19, as these form the basis for the take authorization proposed in this document. These values were presented by Ocean Wind after the habitat-based density models were updated; please see the Revised Density and Take Estimate Memo available at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility* for more information.

Table 18 -- Modeled Potential Level A and Level B Harassment Exposures (assuming 10 dB Sound Attenuation) Due To Impact Pile Driving Of A Monopile Foundation (Assuming 98 Total Monopiles For WTGs) Over 5 Years

Marine Mammal Species	Population Estimate	Level A Harassment (SEL_{cum})	Level B Harassment (160 dB rms)
North Atlantic right whale [a]	368	0.9 [c]	3.11
Blue whale [a]	unknown [b]	n/a [e]	n/a [e]
Fin whale [a]	6,802	3.69	7.05
Sei whale [a]	6,292	0.89	2.00
Minke whale	21,968	18.42	52.25
Humpback whale	1,396	4.24	13.82
Sperm whale [a]	4,349	0	0
Atlantic white-sided dolphin	93,233	0	71.5
Atlantic spotted dolphin	39,921	n/a [e]	n/a [e]
Bottlenose dolphin (offshore stock)	62,851	0	935.91
Bottlenose dolphin (coastal stock)	6,639	0	0
Short-finned pilot whale	28,924	0	0.04
Long-finned pilot whale	39,215	0	0
Risso's dolphin	35,215	0	7.06
Common dolphin	172,974	0	1,229.37
Harbor porpoise [d]	95,543	51.31	233.89
Gray seal	27,300	3.04	197.56
Harbor seal	61,336	12.16	554.22

a – Listed as Endangered under the Endangered Species Act (ESA)
b - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
c - Level A exposures were initially estimated for this species, but due to the mitigation measures that Ocean Wind would be required to abide by, no Level A harassment take would be requested or expected. Instead, the requested Level A harassment take from these exposure estimates was added to the requested Level B harassment take.
d - The calculated Level A exposures are likely an overestimate as the modeled 10 dB sound reduction from the noise mitigation systems does not take into account that the reduction is greater at higher frequencies, which are best heard by harbor porpoises.
e - Exposure modeling for blue whales and Atlantic spotted dolphins was not conducted because the impacts on the species approached zero due to the low density estimates. Because of this, values for these species have been excluded from the quantitative analyses and subsequent tables.

Table 19 -- Modeled Potential Level A and Level B Harassment Exposures (Assuming 10 dB of Sound Attenuation) Due To Impact Pile Driving Of OSS Foundations (Assuming 3 Monopiles Or Three Jackets With 48 Pin Piles) Over 5 Years

Marine Mammal Species	Population Estimate	8/11-m Monopile Foundation Scenario		2.44-m Pin Pile for Jacket Foundation Scenario	
		Level A Harassment (SEL_{cum})	Level B Harassment (160 dB rms)	Level A Harassment (SEL_{cum})	Level B Harassment (160 dB rms)
North Atlantic right whale [a]	368	0.04 [c]	0.14	0.10 [c]	0.75
Blue whale [a]	unknown [b]	n/a [e]	n/a [e]	n/a [e]	n/a [e]
Fin whale [a]	6,802	0.15	0.27	0.48	1.20
Sei whale [a]	6,292	0.04	0.08	0.14	0.45
Minke whale	21,968	0.76	2.32	2.29	15.81
Humpback whale	1,396	0.18	0.51	0.54	3.63
Sperm whale [a]	4,349	0	0	0	0
Atlantic white-sided dolphin	93,233	0	2.37	0	16.20
Atlantic spotted dolphin	39,921	n/a [e]	n/a [e]	n/a [e]	n/a [e]
Bottlenose dolphin (offshore stock)	62,851	0	30.44	0	168.23
Bottlenose dolphin (coastal stock)	6,639	0	0	0	0
Short-finned pilot whale	28,924	0	less than 0.01	0	0

Long-finned pilot whale	39,215	0	0	0	0
Risso's dolphin	35,215	0	0.26	0	1.79
Common dolphin	172,974	0	40.51	0	293.89
Harbor porpoise [d]	95,543	2.38	10.004	16.60	70.97
Gray seal	27,300	0.08	6.98	0.32	38.59
Harbor seal	61,336	0.37	19.76	0.43	99.14

a – Listed as Endangered under the Endangered Species Act (ESA)
b - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
c - Level A harassment exposures were initially estimated for this species, but due to the mitigation measures that Ocean Wind would be required to abide by, no Level A harassment take would be requested or expected. Instead, the requested Level A harassment take from these exposure estimates was added to the requested Level B harassment take.
d - The calculated Level A harassment exposures are likely an overestimate as the modeled 10 dB sound reduction from the noise mitigation systems does not take into account that the reduction is greater at higher frequencies, which are best heard by harbor porpoises.
e - Exposure modeling for blue whales and Atlantic spotted dolphins was not conducted because the impacts on the species approached zero due to the low density estimates. Because of this, values for these species have been excluded from the quantitative analyses and subsequent tables.

Based on the exposure estimates for impact pile driving activities related to WTGs and OSS installation (monopile foundations and/or jacket foundations with pin piles), the take estimates, as proposed by NMFS, are found below in Tables 20 and 21. In the majority of cases, to determine the proposed take numbers, the calculated exposures were rounded to the next whole number, except where explanations have been provided to predict zero takes or to round up to average group size (see footnotes).

Table 20 -- Proposed Level A and Level B Harassment Take Resulting from Impact Pile Driving Associated with the WTG 8/11-m Using Monopile Foundations (Assuming 98 total) Over 5 Years

Marine Mammal Species	Population Estimate	Requested Level A Harassment	Requested Level B Harassment
North Atlantic right whale [a]	368	0 [b]	4
Blue whale [a]	unknown	0	4 [c]
Fin whale [a]	6,802	4	8
Sei whale [a]	6,292	1	2 [d]
Minke whale	21,968	19	53
Humpback whale	1,396	5	14
Sperm whale [a]	4,349	0	3 [d]
Atlantic white-sided dolphin	93,233	0	72
Atlantic spotted dolphin	39,921	0	45 [d]
Bottlenose dolphin (offshore stock)	62,851	0	936
Bottlenose dolphin (coastal stock)	6,639	0	0
Short-finned pilot whale	28,924	0	10 [d]
Long-finned pilot whale	39,215	0	10 [d]
Risso's dolphin	35,215	0	30 [d]
Common dolphin	172,974	0	1,230
Harbor porpoise	95,543	52	234
Gray seal	27,300	4	198
Harbor seal	61,336	13	555

a – Listed as Endangered under the Endangered Species Act (ESA).
b – JASCO's modeling estimated 0.90 Level A harassment exposures for North Atlantic right whales, but due to mitigation measures (see the **Proposed Mitigation** section), no Level A harassment takes are expected or requested.
c – No Level B harassment exposures were estimated for blue whales, but up to 4 Level B harassment takes, which were not calculated through density estimates, are proposed in the event that four individuals approach the monopile installations.
d – The requested take for sei whales (Kenney and Vigness-Raposa, 2010), sperm whales (Barkaszi and Kelly, 2019), Atlantic spotted dolphins (Kenney and Vigness-Raposa, 2010), both species of pilot whales (Kenney and Vigness-Raposa, 2010), and Risso's dolphins (Barkaszi and Kelly, 2019) was adjusted based on mean group size.

Table 21 -- Proposed Level A and Level B Harassment Take Resulting from Impact Pile Driving Associated with OSS Using 8/11-m Monopile Foundations (Assuming 3 total) Or 2.44-m Jacket Foundation Using Pin Piles (48 Total Pin Piles) Over 5 Years

Marine Mammal Species	Population Estimate	Three 8/11-m Monopile Foundation Scenario		48 2.44-m Pin Pile (Jacket Foundation) Scenario	
		Requested Level A Harassment	Requested Level B Harassment	Requested Level A Harassment	Requested Level B Harassment
North Atlantic right whale [a]	368	0	0	0	1
Blue whale [a]	unknown	0	0	0	0
Fin whale [a]	6,802	0	0	0	2
Sei whale [a]	6,292	0	0	0	0
Minke whale	21,968	1	3	3	16
Humpback whale	1,396	0	1	1	4
Sperm whale [a]	4,349	0	0	0	3 b
Atlantic white-sided dolphin	93,233	0	3	0	17
Atlantic spotted dolphin	39,921	0	0	0	45 [b]
Bottlenose dolphin (offshore stock)	62,851	0	31	0	169
Bottlenose dolphin (coastal stock)	6,639	0	0	0	0
Short-finned pilot whale	28,924	0	0	0	10 [b]

Long-finned pilot whale	39,215	0	0	0	10 [b]
Risso's dolphin	35,215	0	0	0	30 [b]
Common dolphin	172,974	0	41	0	294
Harbor porpoise	95,543	3	11	17	71
Gray seal	27,300	0	7	0	39
Harbor seal	61,336	0	20	0	100

a – Listed as Endangered under the Endangered Species Act (ESA).

b – The requested take for sei whales (Kenney and Vigness-Raposa, 2010), sperm whales (Barkaszi and Kelly, 2019), Atlantic spotted dolphins (Kenney and Vigness-Raposa, 2010), both species of pilot whales (Kenney and Vigness-Raposa, 2010), and Risso's dolphins (Barkaszi and Kelly, 2019) was adjusted based on mean group size.

Temporary Cofferdam Installation and Removal (Vibratory Pile Driving) Take Estimates

Similar to the impact pile driving source level modeling, vibratory driving sound source characteristics were generated using the GRLWEAP 2010 wave equation model (Pile Dynamics, Inc., 2010). Installation and removal of the cofferdams were modeled from a single location that was deemed representative of the two potential cable routes. The radiated sound waves were modeled as discrete point sources over the full length of the pile in the water. Ocean Wind is not proposing to employ noise mitigation during vibratory piling; therefore, no abatement is applied.

To estimate the sound field to harassment isopleths generated during installation and removal during pile driving, a practical spreading loss model and a source level of 165.0 dB *re 1 μPa* was used (JASCO, 2021). Ocean Wind did not separately analyze the removal of the cofferdams using a vibratory extractor but has assumed that the removal would be acoustically comparable to the installation. Based on available pile driving data (Caltrans, 2020), this is a conservative assumption.

Given the short duration of the activity and shallow, near coast location, animat exposure modeling was not conducted for cofferdam installation and removal to determine potential exposures from vibratory pile driving. Rather, the modeled acoustic range distances to isopleths corresponding to the relatively small Level A harassment and Level B harassment threshold values were used to calculate the area around the cofferdam predicted to be ensonified daily to levels that exceed the thresholds, or the Ensonified Area. The Ensonified Area is calculated as the following:

$$\textit{Ensonified Area} = \pi r^2,$$

where r is the linear acoustic range distance from the source to the isopleth to Level A harassment or Level B harassment thresholds.

The Level A and Level B harassment threshold distances were mapped in GIS to remove any areas that overlapped land masses or areas where water was blocked by land as these areas would not be ensonified during the cofferdam installation and removal. These results are shown in Table 22.

Table 22 -- Areas Calculated for the Maximum Level A and Level B Harassment Threshold Distances for Vibratory Installation of Sheet Piles

Cofferdam Location	Area of Level A Harassment Zone (km2)				Area of Level B Harassment Zone (km^2)
	Low-frequency cetaceans	Mid-frequency cetaceans	High-frequency cetaceans	Phocid pinnipeds (in water)	
Ocean City HDD	0.024	less than 0.000	0.052	0.009	163.75
BL England HDD					158.59
Farm Property HDD					77.01
ISBP Barnegat Bay HDD					76.70

Animal movement and exposure modeling was not performed by JASCO to determine potential exposures from vibratory pile driving. Rather, the average monthly density value from October through May for each marine mammal species (refer back to Table 9) were then multiplied by the estimated Level A harassment and Level B harassment areas and the expected durations for each component of the cofferdams (*i.e.,* installation and removal). Finally, the resulting value was multiplied by the number of proposed activity days which is, for cofferdam installation and removal, conservatively estimated as 4 days (2 days for installation, 2 days for removal). For Level A harassment, monthly exposures were less than 0.01 for all species except harbor porpoise and harbor seals, which had a few monthly totals that were greater than 0.01, but were always less than 0.04 (see Table 6–9 in the Revised Density and Take Estimate Memo). For Level B harassment, this yielded the exposure estimates found in Table 23.

As previously stated, Ocean Wind anticipates that cofferdam installation and removal would occur only during Year 1 of the construction activities, specifically from October through March, although a small number of cofferdam removals could occur in Year 2 during April or May, but it is not expected.

Table 23 -- Estimated Level B Harassment Exposures by Month from Vibratory Pile Installation and Removal Related To Cofferdams

Marine Mammal Species	Population Estimate	Months								Average Exposures [c]
		January	February	March	April	May	October	November	December	
North Atlantic right whale [a]	368	2.08	1.71	0.97	0.55	0.13	0.09	0.41	1.20	0.89
Blue whale [a]	unknown [b]	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fin whale [a]	6,802	2.21	0.65	1.30	1.64	0.57	0.54	0.55	2.56	1.25
Sei whale [a]	6,292	0.40	0.26	0.48	0.61	0.29	0.09	0.44	0.91	0.44
Minke whale	21,968	0.42	0.48	0.68	9.40	7.42	0.94	0.12	0.28	2.47
Humpback whale	1,396	2.25	1.51	2.28	1.56	0.83	0.90	2.13	4.26	1.96
Sperm whale [a]	4,349	0.03	0.04	0.02	0.06	0.08	0.00	0.15	0.09	0.06
Atlantic white-sided dolphin	93,233	1.49	0.96	1.47	3.84	2.11	1.91	4.06	3.76	2.45
Atlantic spotted dolphin	39,921	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Bottlenose dolphin (offshore stock)	62,851	120.06	38.12	60.99	260.70	653.27	1,019.85	951.596	670.22	471.85
Bottlenose dolphin (coastal stock)	6,639	161.51	61.44	137.20	696.39	1,745.23	2,378.69	1,988.58	1,076.10	1,030.64
Short-finned pilot whale	28,924	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long-finned pilot whale	39,215	0.1	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Risso's dolphin	35,215	0.01	0.00	0.00	0.03	0.02	0.02	0.11	0.21	0.05
Common dolphin	172,974	7.05	3.05	5.43	13.05	8.91	6.24	36.20	24.03	12.99
Harbor porpoise	95,543	39.03	34.32	39.17	51.95	10.28	0.18	0.69	41.18	27.10
Gray seal	27,300	102.96	73.31	81.20	131.83	84.76	126.98	182.25	131.44	114.34
Harbor seal	61,336	287.77	294.92	226.96	368.48	236.92	354.92	509.40	367.39	319.59

a – Listed as Endangered under the Endangered Species Act (ESA).
b - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
c - The average exposure values were calculated using the October through May columns.

Modeling of the Level A harassment exposures resulting from two 18-hrs periods of vibratory pile driving and removal resulted in less than one exposure for all species for each month between October 1 and May 31. Because of this, Ocean Wind anticipates and has only requested Level B harassment from vibratory installation and removal of cofferdams; no Level A harassment is expected. However, due to the coastal location of the cofferdams, some Level A harassment takes of the coastal stock of bottlenose dolphins and both species of phocids have been requested to be conservative.

From the exposures calculated shown in Table 23, Ocean Wind utilized the average monthly value from October through May in their proposed take request, which are shown in Table 24. For some species, calculated Level B harassment exposures were zero or very low, but Ocean Wind requested take of an average group size and NMFS concurred this was appropriate given the species potential occurrence in the area.

Table 24 -- Proposed Level A and Level B Harassment Take Resulting From Vibratory Pile Driving Associated With The Installation and Removal of Temporary Cofferdams Over 5 Years

Marine Mammal Species	Population Estimate	Requested Level A Harassment	Requested Level B Harassment
North Atlantic right whale [a]	368	0	1
Blue whale [a]	unknown	0	0
Fin whale [a]	6,802	0	2
Sei whale [a]	6,292	0	1
Minke whale	21,968	0	3
Humpback whale	1,396	0	3
Sperm whale [a]	4,349	0	0
Atlantic white-sided dolphin	93,233	0	5
Atlantic spotted dolphin	39,921	0	45 [b]
Bottlenose dolphin (offshore stock)	62,851	0	472
Bottlenose dolphin (coastal stock) [f]	6,639	11 [c]	1,031
Short-finned pilot whale	28,924	0	10 [d]
Long-finned pilot whale	39,215	0	10 [d]
Risso's dolphin	35,215	0	30 [d]

Common dolphin	172,974	0	13
Harbor porpoise	95,543	0	28
Gray seal	27,300	28 [e]	115
Harbor seal	61,336	28 [e]	320

a – Listed as Endangered under the Endangered Species Act (ESA).
b – No Level B harassment exposures were estimated for Atlantic spotted dolphins, but Ocean Wind has requested a group size estimate of up to 45 Level B harassment takes.
c – No Level A harassment exposures were estimated for bottlenose dolphins of the coastal stock but a group size estimate of 11 Level A harassment takes have been requested by Ocean Wind.
d – Level B harassment takes for pilot whales (short-finned and long-finned; Kenney and Vigness-Raposa, 2010) and Risso's dolphins (Barkaszi and Kelly, 2019) were adjusted to account for an average pod size.
e –No Level A harassment exposures were estimated for gray seals and harbor seals, but 28 Level A harassment takes have been requested in the event up to 2 animals are taken during either removal or installation of cofferdams due to the nearshore location of the cofferdams and seal haulouts.
f - The estimate for coastal bottlenose dolphins (bayside versus Atlantic Ocean-facing) is likely an overestimate as this stock has demonstrated a preference for coastal environments as opposed to estuarine (Toth et al., 2011).

UXO/MEC Detonation

To assess the impacts from UXO/MEC detonations, JASCO conducted acoustic modeling based on previous underwater acoustic assessment work that was performed jointly between NMFS and the United States Navy. JASCO evaluated the effects thresholds (for TTS, PTS, non-auditory injury, and mortality) based on the appropriate metrics to use as indicators of disturbance and injury: (1) peak pressure level; (2) sound exposure level (SEL); and (3) acoustic impulse. Charge weights of 2.3 kgs, 9.1 kgs, 45.5 kgs, 227 kgs, and 454 kgs, which is the largest charge the Navy considers for the purposes of its analyses (see the Description of the Specified Activities section), were modeled to determine the ranges to mortality, gastrointestinal injury, lung injury, PTS, and TTS thresholds. These charge weights were modeled at four different locations off Massachusetts, consisting of different depths (12 m (Site S1), 20 m (Site S2), 30 m (Site S3), and 45 m (Site S4)). The sites were deemed to be representative of both the export cable route and the lease area. Here, we present distances to PTS and TTS thresholds for only the 454 kg UXO/MEC as this has the greatest potential for these impacts. Ocean Wind would be committed to mitigating these distances. Due to the implementation of mitigation and monitoring measures, the potential for mortality and non-auditory injury is low and Ocean Wind did not request, and we are not proposing to authorize take by mortality or non-auditory injury. For this reason we are not presenting all modeling results here; however, they can be found in Appendix C of the application.

- Shallow water ECR: Site S1; In the channel within Narragansett Bay (12 m depth);
- Shallow water ECR: Site S2; Intermediate waters outside of Narragansett Bay (20 m depth);
- Shallow water lease area: Site S3; Shallower waters in the southern portion of the Hazard Zone 2 area (30 m depth);
- Deeper water lease area: Site S4; Deeper waters in northern portion of the Hazard Zone 2 area (45 m depth).

In their UXO/MEC modeling report (Appendix C of Ocean Wind's ITA application), JASCO notes that although the sample sites were located offshore of Massachusetts, the chosen sites share similar depths, sea surface, and seabed conditions as the project area where Ocean Wind 1 is proposed to be developed and making it an ideal as a proxy.

Based on the depths within the Ocean Wind 1 location, Site S1 (12 m) was chosen as the most representative depth to assess UXO/MEC detonations within the export cable route corridor. Sites S2, S3, and S4 (20 m, 30 m, and 45 m) are applicable to the wind farm area (*i.e.,* location of the WTGs and OSSs). The SEL-based ($R_{95\%}$) isopleths for Level A harassment (PTS) and Level B harassment (TTS) were calculated from the horizontal distances shown in Tables 25 and 26. For all species, the distance to the SEL thresholds exceeded that for the peak thresholds. Model results for all sites and all charge weights can be found in Appendix C of Ocean Wind's application. Further, JASCO presented the results for both mitigated and unmitigated scenarios in the ITA application. Since that time, Ocean Wind has committed to the use of a noise mitigation system during all detonations, and plans to achieve a 10 dB noise reduction as minimum. As a result, the August 2022 Revised Density and Take Estimate Memo carried forward only the mitigated UXO/MEC scenario. Therefore, only the attenuated results are presented in Tables 25 and 26 and were carried forward into the exposure and take estimation. Additional information can be found in JASCO's UXO/MEC report and the Revised Density and Take Estimate Memo on NMFS' website (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility*).

NMFS notes that the more detailed results for the mortality and non-auditory injury analysis to marine mammals for onset gastrointestinal injury, onset lung injury, and onset of mortality can be found in Appendix C of the ITA application, which can be found on NMFS' website. NMFS preliminarily concurs with Ocean Wind's analysis and does not expect or propose to authorize any non-auditory injury, serious injury, or mortality of marine mammals from UXO/MEC detonation. The modeled distances to the mortality threshold for all UXO/MECs sizes for all animal masses are small (*i.e.,* 5–553 m; see Table 38 in Appendix C of Ocean Wind's application), as compared to the distance/area that can be effectively monitored. The modeled distances to non-auditory injury thresholds range from 5–658 m (see Tables 30 and 34 in Appendix C of the application). Ocean Wind would be required to conduct extensive monitoring using both PSOs and PAM operators and clear an area of marine mammals prior to detonating any UXO. Given that Ocean Wind would be employing multiple platforms to visually monitor marine mammals as well as passive acoustic monitoring, it is reasonable to assume that marine mammals would be reliably detected within approximately 660 m of the UXO/MEC being detonated, the potential for mortality or non-auditory injury is *de minimis.*

Table 25 -- Greatest SEL-based $R_{95\%}$ PTS-Onset Ranges (In Meters) From All Sites Modeled During UXO/MEC Detonation, Assuming 10 dB Sound Reduction

Marine Mammal Hearing Group	Distance (m) to PTS Threshold During E12 (454 kg) detonation	
	R_{max}	$R_{95\%}$
Low-frequency cetaceans	4,270	3,780
Mid-frequency cetaceans	535	461
High-frequency cetaceans	6,750	6,200
Phocid pinnipeds (in water)	1,830	1,600

Table 26 -- Greatest SEL-based $R_{95\%}$ TTS-onset Ranges (In Meters) From All Sites Modeled During UXO/MEC Detonation, Assuming 10 dB Sound Reduction

Marine Mammal Hearing Group	Distance (m) to PTS Threshold During E12 (454 kg) detonation	
	R_{max}	$R_{95\%}$
Low-frequency cetaceans	13,200	11,900
Mid-frequency cetaceans	2,930	2,550
High-frequency cetaceans	15,600	14,100
Phocid pinnipeds (in water)	7,610	7,020

JASCO's take estimate analysis assumed that all 10 of the potential UXOs/MECs would be 454 kg in weight. Although Ocean Wind does not expect that all UXOs/MECs would consist of this charge weight, they assumed as much to be conservative in estimating take. The take estimate calculations assume that the ten 454 kg charges would be split between the different depths (20 m–45 m), as these were considered representative for the project area.

To calculate the potential marine mammal exposures from any UXO/MEC detonations, the horizontal distances from Tables 25 and 26 were multiplied by the highest monthly species density in the Wind Farm Area (based on the Revised Density and Take Estimate Memo) for each of the 20 m to 45 m representative depths and by the highest monthly species density in the export cable route for the 12 m depth (see Table 11 for the densities used and Table 6–Y NEW from the Revised Density and Take Estimate Memo for all of the available densities from May through October). The resulting value from the areas multiplied by the respective species densities were then multiplied by the number of UXOs/MECs estimated at each of the depths (two UXOs/MECs at 12 m, three UXOs/MECs at 20 m, three UXOs/MECs at 30 m, and two UXOs/MECs at 40 m), for a total of 10 predicted UXOs. However, Ocean Wind has committed not to conduct more than one UXO/MEC detonation on any given day.

Level A harassment exposures resulting from UXO/MEC detonations are considered unlikely, but possible. To reduce impacts, a noise abatement system (likely a bubble curtain or similar device) capable of achieving 10 dB of sound attenuation would be implemented. This level of sound reduction is considered achievable and reasonable given work being done in European waters (Bellmann *et al.,* 2020; Bellmann and Betke, 2021).

The estimated maximum PTS and TTS exposures assuming 10 dB of sound attenuation are presented in Table 27. These results are found in Appendix C, Tables 15 and 16 of Ocean Wind's ITA application (Ocean Wind, 2022b). As indicated previously, where there is no more than one detonation per day, the TTS threshold is expected to also appropriately represent the level above which any behavioral disturbance might occur; so the Level B harassment exposures noted below could include TTS or behavioral disturbance.

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Table 27 -- Estimated Potential Maximum PTS and TTS Exposures Of Marine Mammals Resulting From The Possible Detonations Of Up To 10 UXOs/MECs Assuming 10 dB Of Sound Attenuation

Marine Mammal Species	Population Estimate	Assuming 10 dB of Sound Attenuation	
		Level A Harassment (PTS SEL)	Level B Harassment (TTS SEL)
North Atlantic right whale [a, c]	368	0.03	0.35
Blue whale [a]	Unknown [b]	less than 0.01	0.04
Fin whale [a]	6,802	0.28	2.87
Sei whale [a]	6,292	0.08	0.87
Minke whale	21,968	2.53	26.42
Humpback whale	1,396	0.33	3.41
Sperm whale [a]	4,349	less than 0.01	0.01
Atlantic white-sided dolphin	93,233	0.03	1.05
Atlantic spotted dolphin	39,921	n/a	n/a
Bottlenose dolphin (offshore stock)	62,851	0.68	24.36
Bottlenose dolphin (coastal stock)	6,639	3.84	137.31
Short-finned pilot whale	39,215	less than 0.01	0.02
Long-finned pilot whale	28,924	less than 0.01	0.02
Risso's dolphin	35,215	less than 0.01	0.04
Common dolphin	172,974	0.13	4.65
Harbor porpoise	95,543	9.49	46.50
Gray seal	27,300	2.28	50.98
Harbor seal	61,336	6.39	142.49

a – Listed as Endangered under the Endangered Species Act (ESA).
b - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
c - Level A harassment exposures were estimated for this species, but due to mitigation measures outlined in Section 11, no Level A harassment takes are expected or requested. See Section 6.2.3 of the ITA application for more information.

Table 27 presents the attenuated (10 dB) PTS and TTS take estimates. Although the original ITA application described and analyzed the unattenuated estimates given uncertainty with exact mitigation during UXO/MEC detonations, given the commitment by Ocean Wind to mitigate the proposed UXO/MEC detonations, NMFS concurs that it is appropriate to carry forward the take estimates from the mitigated (10 dB sound attenuation) scenario that are found in the Revised Density and Take Estimate Memo received in August 2022 (Table 28).

Table 28 -- Proposed Level A Harassment and Level B Harassment Takes Resulting From The Detonation Of Up To 10 UXOs, Assuming 10 dB of Sound Attenuation, Over 5 Years

Marine Mammal Species	Population Estimate	Requested Level A Harassment	Requested Level B Harassment
North Atlantic right whale [a]	368	0	1
Blue whale [a]	unknown [d]	0	0
Fin whale [a]	6,802	0	3
Sei whale [a]	6,292	0	1
Minke whale	21,968	0 [b]	27
Humpback whale	1,396	0	4
Sperm whale [a]	4,349	0	3 [c]
Atlantic white-sided dolphin	93,233	0	2
Atlantic spotted dolphin	39,921	0	45 [c]
Bottlenose dolphin (offshore stock)	62,851	0 [b]	25
Bottlenose dolphin (coastal stock)	6,639	0 [b]	138
Short-finned pilot whale	28,924	0	10 [c]
Long-finned pilot whale	39,215	0	10 [c]
Risso's dolphin	35,215	0	30 [c]
Common dolphin	172,974	0	5
Harbor porpoise	95,543	10	47
Gray seal	27,300	3	51
Harbor seal	61,336	7	143

a – Listed as Endangered under the Endangered Species Act (ESA).
b – A small amount of Level A harassment exposures were estimated based on the density calculations, but no Level A harassment take is being requested due to the mitigation measures Ocean Wind would be required to implement.
c – The requested take for the sperm whale (Barkaszi and Kelly, 2019), the Atlantic spotted dolphin (Kenny and Vigness-Raposa, 2010), both pilot whale species (Kenny and Vigness-Raposa, 2010), and the Risso's dolphins (Barkaszi and Kelly, 2019) were adjusted based on mean group size.
d - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.

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Due to mitigation measures that would be implemented during any UXO/MEC detonations, the likelihood of Level A harassment take and some Level B harassment take for some species was reduced. However, there is still potential for Level A harassment take for some species, such as for harbor porpoises and both harbor and gray seals.

HRG Surveys

NMFS considers the data provided by Crocker and Fratantonio (2016) to represent the best available information on source levels associated with HRG equipment and, therefore, recommends that source levels provided by Crocker and Fratantonio (2016) be incorporated in the method described above to estimate ranges to the Level A harassment and Level B harassment isopleths. In cases when the source level for a specific type of HRG equipment is not provided in Crocker and Fratantonio (2016), NMFS recommends that either the source levels provided by the manufacturer be used, or, in instances where source levels provided by the manufacturer are unavailable or unreliable, a proxy from Crocker and Fratantonio (2016) be used instead. Ocean Wind utilized the following criteria for selecting the appropriate inputs into the NMFS User Spreadsheet Tool (NMFS, 2018):

(1) For equipment that was measured in Crocker and Fratantonio (2016), the reported SL for the most likely operational parameters was selected.

(2) For equipment not measured in Crocker and Fratantonio (2016), the best available manufacturer specifications were selected. Use of manufacturer specifications represent the absolute maximum output of any source and do not adequately represent the operational source. Therefore, they should be considered an overestimate of the sound propagation range for that equipment.

(3) For equipment that was not measured in Crocker and Fratantonio (2016) and did not have sufficient manufacturer information, the closest proxy source measured in Crocker and Fratantonio (2016) was used.

The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the HRG surveys. These included variants of the Dura-spark sparker system and various configurations of the GeoMarine Geo-Source sparker system. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available. Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP–D700 and CSP–N). The CSP–D700 power source was used in the 700 joules (J) measurements but not in the 1,000 J measurements. The CSP–N source was measured for both 700 J and 1,000 J operations but resulted in a lower source level; therefore, the single maximum source level value was used for both operational levels of the S-Boom.

Table 29 identifies all the representative survey equipment that operates below 180 kHz (*i.e.,* at frequencies that are audible and have the potential to disturb marine mammals) that may be used in support of planned survey activities, and are likely to be detected by marine mammals given the source level, frequency, and beamwidth of the equipment. The lowest frequency of the source was used when calculating the absorption coefficient.

Table 29 -- Summary of Representative HRG Equipment Ocean Wind May Use During the Project

Equipment Type	Representative HRG Equipment	Operating Frequency	SL_{rms} (dB re 1 μPa m)	$SL_{0\text{-}pk}$ (dB re 1 μPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	CF = Crocker and Fratantonio (2016) MAN = manufacturer
Non-parametric shallow penetration SPBs (non-impulsive)								
Sub-bottom Profiler	ET 216 (2000DS or 3200 top unit)	2-16	195	-	20	6	24	MAN
		2-8						
	ET 424	4-24	176	-	3.4	2	71	CF
	ET 512	0.7-12	179	-	9	8	80	CF
	GeoPulse 5430A	2-17	196	-	50	10	55	MAN
	Teledyne Benthos Chirp III - TTV 170	7-2	197	-	60	15	100	MAN
Medium penetration SBPs (impulsive)								
Sparker	AA, Dura-spark (400 tips, 500J)[a]	0.3-1.2	203	211	1.1	4	Omni	CF
	AA, triple plate S-Boom (700-1,000J)[b]	0.1-5	205	211	0.6	4	80	CF

- = not applicable; ET = EdgeTech; J = joule; kHz = kilohertz; dB = decibels; SL = source level; UHD = ultra-high definition; AA = Applied Acoustics; rms = root-mean square; µPa = microPascals; re = referenced to; SPL = sound pressure level; PK = zero-to-peak pressure level; Omni = omnidirectional source.

Notes: All source information that was used to calculate threshold isopleths are provided in Table 1.

a - The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the survey. These include variants of the Dura-spark sparker system and various configurations of the GeoMarine Geo-Source sparker system. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available.

b - Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP–D700 and CSP–N). The CSP–D700 power source was used in the 700 J measurements but not in the 1,000 J measurements. The CSP–N source was measured for both 700 J and 1,000 J operations but resulted in a lower SL; therefore, the single maximum SL value was used for both operational levels of the S-Boom.

When the NMFS Technical Guidance (2016) was published, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, we developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to help predict takes. We note that because of some of the assumptions included in the methods used for these tools, we anticipate that isopleths produced are typically going to be overestimates of some degree, which may result in some degree of overestimation of Level A harassment. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For mobile sources (such as the active acoustic sources proposed for use during Ocean Wind's HRG surveys), the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed. JASCO modeled distances to Level A harassment isopleths for all types of HRG equipment and all marine mammal functional hearing groups using the NMFS User Spreadsheet and NMFS Technical Guidance (2018).

For HRG surveys, in order to better consider the narrower and directional beams of the sources, NMFS has developed an additional tool for determining the sound pressure level (SPL_{rms}) at the 160-dB isopleth for the purposes of estimating the extent of Level B harassment isopleths associated with HRG survey equipment (NMFS, 2020). This methodology incorporates frequency-dependent absorption and some directionality to refine estimated ensonified zones. Ocean Wind used NMFS' methodology with additional modifications to incorporate a seawater absorption formula and account for energy emitted outside of the primary beam of the source. For sources that operate with different beam widths, the maximum beam width was used (see Table 30). The lowest frequency of the source was used when calculating the absorption coefficient.

Table 30 -- Distance To Weighted Level A Harassment and Level B Harassment Thresholds For Each HRG Sound Source or Comparable Sound Source Category For Each Marine Mammal Hearing Group

Equipment Type	HRG Sources	Distance to Level A harassment threshold (m)					Distance to Level B harassment threshold (m)
		Low-frequency cetaceans (SEL_{CUM})	Mid-frequency cetaceans (SEL_{CUM})	High-frequency cetaceans (SEL_{CUM})	High-frequency cetaceans (SPL_{0-PK})	Phocid pinnipeds (in water; SEL_{CUM})	All (SPL_{rms})
Non-impulsive, non-parametric, shallow SBP (CHIRPs)							
Sub-bottom Profilers (CHIRPs)	EdgeTech 216	less than 1	less than 1	2.9	n/a	0	9
	EdgeTech 424	0	0	0	n/a	0	4
	EdgeTech 512i	0	0	less than 1	n/a	0	6
	GeoPulse 5430	less than 1	less than 1	36.5	n/a	less than 1	21
	Teledyn Benthos Chirp III - TTV 170	1.5	less than 1	16.9	n/a	less than 1	48
Impulsive, medium SBP (Boomers and Sparkers)							
Boomer	AA Triple plate S-Boom (700/1,000 J)	less than 1	0	0	4.7	less than 1	34
Sparker	AA Dura-spark UHD (500 J/400 tip)	less than 1	0	0	2.8	less than 1	141
	AA Dura-spark UHD 400+400	less than 1	0	0	2.8	less than 1	141
	GeoMarine Geo-Source dual 400 tip sparker	less than 1	0	0	2.8	less than 1	141

Potential exposures of marine mammals to acoustic impacts from HRG survey activities were estimated by assuming an active survey distance of 70 km per 24-hour period. This assumes the vessel would be traveling at a speed of 4 knots and only during periods where active acoustics were being used with frequency ranges less than 180 kHz. A vessel that would only operate during daylight hours is assumed to have an active survey distance of 35 km.

To maintain a potential for 24-hour HRG surveys, the corresponding Level A and Level B harassment areas were calculated for each source based on the threshold distances, assuming a 70 km operational period (Table 31).

Table 31 -- Calculated Areas (With Distances (m) In Parenthesis) Encompassing the Level A and Level B Harassment Thresholds[a] for Representative Acoustic Source

Acoustic Source	Level A Harassment Isopleth Area (in km²) and Distance (m) [b]				Level B Harassment Isopleth Area (in km²) and Distance (m)[c]
	Marine Mammal Hearing Group				
	Low-frequency cetaceans	Mid-frequency cetaceans	High-frequency cetaceans	Phocid pinnipeds (in water)	All Marine Mammal Hearing Groups
Non-impulsive, non-parametric, shallow SBP (CHIRPs)					
ET 216 CHIRP	0 (less than 1)	0 (less than 1)	0.4 (2.9)	0 (0)	1.3 (9)
ET 424 CHIRP	0 (0)	0 (0)	0 (0)	0 (0)	0.6 (4)
ET 512i CHIRP	0 (0)	0 (0)	0 (less than 1)	0 (less than 1)	0.8 (21)
GeoPulse 5430	0 (less than 1)	0.1 (less than 1)	5.1 (36.5)	0 (less than 1)	2.9 (21)
TB CHIRP III	0.2 (1.5)	0 (less than 1)	2.4 (16.9)	0.1 (less than 1)	6.7 (48)
Impulsive, medium SBP (Boomers and Sparkers)					
AA Triple plate S-Boom (700-1,000 J)	0.1 (less than 1)	0 (0)	0.7 (0)	0 (SEL_{CUM}: 0; $SPL_{0\text{-}PK}$: 4.7)	4.8 (34)
AA, Dura-spark UHD	0.1 (less than 1)	0 (0)	0.4 (0)	0 (SEL_{CUM}: 0; $SPL_{0\text{-}PK}$: 2.8)	19.8 (141)

a – The Level A and B harassment isopleths were calculated to comprehensively assess the potential impacts of the predicted source operations as required for the ITA application (Ocean Wind, 2022b). As described in the ITA application, minimal Level A harassment takes are expected and were included.
b – Based on maximum distances in Table 1-30 of the ITA application (Ocean Wind, 2022b). For consistency, the metric producing the largest distance to the Level A harassment thresholds (either cumulative sound exposure level or zero to peak sound pressure level) was used to calculate the areas for each hearing group.
c – Based on maximum distances in Table 1-30 of the ITA application calculated for Level B harassment root-mean-square sound pressure level thresholds (Ocean Wind, 2022b).

Results of modeling using the methodology described above indicated that, of the HRG survey equipment planned for use by Ocean Wind that has the potential to result in Level B harassment of marine mammals, sound produced by the Applied Acoustics Dura-Spark UHD sparkers and GeoMarine Geo-Source sparker would propagate furthest to the Level B harassment threshold (141 m; Table 31). For the purposes of the exposure analysis, it was conservatively assumed that sparkers would be the dominant acoustic source for all survey days. Thus, the distances to the isopleths corresponding to the threshold for Level B harassment for sparkers (141 m) was used as the basis of the take calculation for all marine mammals.

The modeled distances to isopleths corresponding to the Level A harassment threshold are very small (less than 1 m) for three of the four marine mammal functional hearing groups that may be impacted by the proposed activities (*i.e.,* low frequency and mid frequency cetaceans, and phocid pinnipeds). The largest distance to the Level A harassment isopleth is 36.5 m, associated with use of the GeoPulse 5430A. Because this distance is small, coupled with the characteristics of sounds produced by HRG equipment in general (including the GeoPulse 5430A), neither NMFS nor Ocean Wind anticipates Level A harassment during HRG surveys, even absent mitigation. Therefore, Ocean Wind has not requested and NMFS has not proposed authorizing Level A harassment take incidental to HRG surveys.

The estimated exposures were calculated using the average density for the 12 months for each marine mammal species, or the annual density when only one value was available. These densities were multiplied by the number of proposed survey days (Years 1, 4, 5 = 88; Years 2, 3 = 180) and then by the area ensonified per day (70 km multiplied by the areas found in Table 31). This approach was taken because Ocean Wind does not know which months HRG surveys would occur in. This approach produced a conservative estimate of exposures and, subsequently, take for each species.

Based on the analysis above, the modeled Level A and B harassment exposures of marine mammals resulting from HRG survey activities are shown in Table 32.

Table 32 -- Calculated Annual Maximum Level A and B Harassment Exposures of Marine Mammals Resulting From HRG Surveys

Marine Mammal Species	Population Estimate	Estimated Level A Harassment Exposures [b]		Estimated Level B Harassment Exposures	
		Years 1, 4, and 5 (88 days annually)	Years 2 and 3 (180 days annually)	Years 1, 4, and 5 (88 days annually)	Years 2 and 3 (180 days annually)
North Atlantic right whale [a]	368	less than 0.01	0.01	0.46	0.94
Blue whale [a]	Unknown	less than 0.01	less than 0.01	0.02	0.03
Fin whale [a]	6,802	0.01	0.02	1.24	2.56
Sei whale [a]	6,292	less than 0.01	less than 0.01	0.33	0.68
Minke whale	21,968	0.02	0.04	2.40	4.98
Humpback whale	1,396	0.01	0.02	1.10	2.27
Sperm whale [a]	4,349	less than 0.01	less than 0.01	0.04	0.09
Atlantic white-sided dolphin	93,233	0.03	0.05	4.79	10.04

Atlantic spotted dolphin	39,921	n/a	n/a	n/a	n/a
Bottlenose dolphin (offshore stock)	62,851	1.23	2.46	173.84	348.37
Bottlenose dolphin (coastal stock)	6,639	3.28	6.60	464.18	933.46
Short-finned pilot whales	39,215	less than 0.01	less than 0.01	0.14	0.29
Long-finned pilot whales	28,924	less than 0.01	less than 0.01	0.19	0.40
Risso's dolphin	35,215	less than 0.01	less than 0.01	0.31	0.65
Common dolphin	172,974	0.20	0.42	28.38	59.52
Harbor porpoise	95,543	5.60	11.59	21.69	44.88
Gray seal	27,300	0.23	0.48	33.23	67.56
Harbor seal	61,336	0.66	1.34	92.88	188.83

a – Listed as Endangered under the Endangered Species Act (ESA).

b – Some Level A harassment exposures were estimated to occur during HRG surveys, but due to the proposed mitigation measures Ocean Wind would be required to undertake, no Level A harassment takes were carried forward.

NMFS reiterates that any proposed to be authorized takes would be by Level B harassment only, in the form of disruption of behavioral patterns for individual marine mammals resulting from exposure to noise from certain HRG acoustic sources. Based primarily on the characteristics of the signals produced by the acoustic sources planned for use and due to the small PTS zones associated with HRG equipment types proposed for use, Level A harassment is neither anticipated (even absent mitigation), nor proposed to be authorized. Consideration of the anticipated effectiveness of the measures (*i.e.,* exclusion zones and shutdown measures), discussed in detail below in the Proposed Mitigation section, further strengthens the conclusion that Level A harassment is not a reasonably anticipated outcome of the survey activity. Ocean Wind did not request authorization of take by Level A harassment, and no take by Level A harassment is proposed for authorization by NMFS. As described previously, no serious injury or mortality is anticipated or proposed to be authorized for this activity.

The proposed take estimates presented here assumed that HRG surveys would be occurring for 24 hours each day. Adjustments based on the mean group size estimates (*i.e.,* increasing take to the mean group size if the calculated exposures were fewer) were included for the following species: sei whales (Kenney and Vigness-Raposa, 2010), minke whales (Kenney and Vigness-Raposa, 2010), humpback whales (CeTAP, 1982), sperm whales (Barkaszi and Kelly, 2019), Atlantic spotted dolphins (Kenney and Vigness-Raposa, 2010), both species of pilot whales (Kenney and Vigness-Raposa, 2010), and Risso's dolphins (Barkaszi and Kelly, 2019).

Years 1, 4, and 5 in Table 33 below represent HRG surveys occurring during the pre- and post-construction phases of Ocean Wind's proposed project. Each of these years is based on an annual HRG survey effort of 88 days (264 total effort over 3 years). Years 2 and 3 would include HRG surveys occurring during the construction of other elements of Ocean Wind's project. Each of these years is based on an annual HRG survey effort of 180 days (360 days total over 2 years).

Table 33 -- Proposed Level A and Level B Harassment Take Resulting From High-Resolution Site Characterization Surveys Over 5 Years

Marine Mammal Species	Population Estimate	Pre- and Post-Construction Phases (Years 1, 4, 5; 88 days annually)		During Construction Phase (Years 2 and 3; 180 days annually)	
		Requested Level A Harassment	Requested Level B Harassment	Requested Level A Harassment	Requested Level B Harassment
North Atlantic right whale [a]	368	0	1 [d]	0	2 [d]
Blue whale [a]	unknown	0	0	0	0
Fin whale [a]	6,802	0	2	0	3
Sei whale [a]	6,292	0	0 [b]	0	1 [b]
Minke whale	21,968	0	3 [b]	0	5 [b]
Humpback whale	1,396	0	2 [b]	0	3 [b]
Sperm whale [a]	4,349	0	3 [b]	0	3 [b]
Atlantic white-sided dolphin	93,233	0	5	0	11
Atlantic spotted dolphin	39,921	0	45 [b]	0	45 [b]
Bottlenose dolphin	62,851	0 [c]	173	0 [c]	349

(offshore stock)					
Bottlenose dolphin (coastal stock)	6,639	0 [c]	465	0 [c]	934
Short-finned pilot whale	28,924	0	10 [b]	0	10 [b]
Long-finned pilot whale	39,215	0	10 [b]	0	10 [b]
Risso's dolphin	35,215	0	30 [b]	0	30 [b]
Common dolphin	172,974	0	29	0	60
Harbor porpoise	95,543	0 [c]	22	0 [c]	45
Gray seal	27,300	0 [c]	34	0 [c]	68
Harbor seal	61,336	0 [c]	93	0 [c]	189

a – Listed as Endangered under the Endangered Species Act (ESA).
b – The following species' requested take was a adjusted based on mean group size: Sei whale (Kenney and Vigness-Raposa, 2010), minke whale (Kenney and Vigness-Raposa, 2010), humpback whale (CeTAP, 1982), sperm whale (Barkaszi and Kelly, 2019), Atlantic spotted dolphin (Kenney and Vigness-Raposa, 2010), both species of pilot whale (Kenney and Vigness-Raposa, 2010), and Risso's dolphin (Barkaszi and Kelly, 2019).
c – A small amount of Level A harassment exposures were estimated based on the density calculations, but no Level A harassment take is being requested by Ocean Wind due to the mitigation measures planned for use.
d - Based on the exposure estimates, values greater than 0.5 for all other species besides North Atlantic right whale were rounded up to 1. Take estimates for North Atlantic right whales from 0.45 and up were rounded up to 1 (to be conservative) and 0.93 was rounded to 2.

Total Proposed Ocean Wind Take Across All Activity Types

Level A harassment and Level B harassment proposed takes for the combined activities of impact pile driving assuming 10 dB of sound attenuation during the installation of monopiles and/or pin piles; vibratory pile driving for cofferdam installation and removal; HRG surveys; and potential UXO/MEC detonation (no sound attenuation) are provided in Table 34. NMFS also presents the percentage of each marine mammal stock estimated to be taken based on the total amount of take in Table 35. The mitigation and monitoring measures provided in the Proposed Mitigation and Proposed Monitoring and Reporting sections are activity-specific and are designed to minimize acoustic exposures to marine mammal species.

The take numbers NMFS proposed for authorization (Table 35) are considered conservative for the following key reasons:

- Proposed take numbers for impact pile driving assume a maximum piling schedule (two monopiles and three pin piles installed per 24-hour period);
- Proposed take numbers for vibratory pile driving assume that a sheet pile temporary cofferdam will be installed (versus the alternative installation of a gravity cell cofferdam, for which no take is anticipated);
- Proposed take numbers for pile driving are conservatively based on maximum densities across the proposed construction months; and,
- Proposed Level A harassment take numbers do not fully account for the likelihood that marine mammals will avoid a stimulus when possible before the individual accumulates enough acoustic energy to potentially cause auditory injury, or the effectiveness of the proposed mitigation measures.

The Year 1 take estimates include 88 days of HRG surveys, cofferdam installation/removal, and mitigated UXO/MEC detonations. Year 2 includes 180 days of HRG surveys, WTG impact installation using monopile foundations, and OSS impact installation using pin piles for jacket foundations. Year 3 includes 180 days of HRG surveys only. And Years 4 and 5 include 88 days of HRG surveys. Although temporary cofferdam installation/removal could occur in Year 2, all of the proposed takes were allocated to Year 1 as this represents the most accurate construction scenario. All impact pile driving activities for the WTGs and OSSs could also occur outside of Year 2; however, all of the takes were allocated to Year 2 as this represents the most likely scenario.

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Table 34 -- Proposed Level A and Level B Harassment Takes For All Activities Proposed To Be Conducted During The Construction and Development Of The Ocean Wind 1 Offshore Wind Energy Facility

Marine Mammal Species	Population Estimate	2024 (Year 1)		2025 (Year 2)		2026 (Year 3)		2027 (Year 4)		2028 (Year 5)	
		Level A Harassment	Level B Harassment	Level A HarassmentA	Level B Harassment	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment
North Atlantic right whale [a]	368	0	3	0	7	0	2	0	1	0	1
Blue whale [a]	Unknown [b]	0	0	0	4	0	0	0	0	0	0
Fin whale [a]	6,802	0	7	4	13	0	3	0	2	0	2
Sei whale [a]	6,292	0	2	1	3	0	1	0	0	0	0
Minke whale	21,968	0	33	22	74	0	5	0	3	0	3
Humpback whale	1,396	0	9	6	21	0	3	0	2	0	2
Sperm whale [a]	4,349	0	6	0	6	0	3	0	3	0	3
Atlantic white-sided dolphin	93,233	0	12	0	100	0	11	0	5	0	5
Atlantic spotted dolphi	39,921	0	135	0	135	0	45	0	45	0	45

n											
Bottlenose dolphin (offshore stock)	62,851	0	671	0	1,454	0	349	0	174	0	174
Bottlenose dolphin (coastal stock) [c]	6,639	11	1,634	0	934	0	934	0	465	0	465
Long-finned pilot whale	28,924	0	30	0	30	0	10	0	10	0	10
Short-finned pilot whale	39,215	0	30	0	30	0	10	0	10	0	10
Risso's dolphin	35,215	0	90	0	90	0	30	0	30	0	30
Common dolphin	172, 974	0	47	0	1,584	0	60	0	29	0	29
Harbor porpoise	95,543	10	97	69	350	0	45	0	22	0	22
Gray seal	27,300	31	200	4	305	0	68	0	68	0	34
Harbor seal	61,336	35	556	13	844	0	189	0	93	0	93

a – Listed as Endangered under the Endangered Species Act (ESA).

b - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.

c - The estimate for coastal bottlenose dolphins (bayside versus Atlantic Ocean-facing) is likely an overestimate as this stock has demonstrated a preference for coastal environments as opposed to estuarine (Toth et al., 2011).

Table 35 -- Total 5-Year Requested Takes (Level A Harassment And Level B Harassment) All Activities Proposed To Be Conducted During The Construction and Development Of The Ocean Wind 1 Offshore Wind Energy Facility

Marine Mammal Species	Population Size	5-Year Project Duration [b]		
		Level A Harassment	Level B Harassment	Total 5-Year
North Atlantic right whale [a]	368	0	14	14
Blue whale [a]	Unknown [c]	0	4	4
Fin whale [a]	6,802	4	27	31
Sei whale [a]	6,292	1	6	7
Minke whale	21,968	22	118	140
Humpback whale	1,396	6	37	43
Sperm whale [a]	4,349	0	21	21
Atlantic white-sided dolphin	93,233	0	133	133
Atlantic spotted dolphin	39,921	0	405	405
Bottlenose dolphin (offshore stock)	62,851	0	2,822	2,822
Bottlenose dolphin (coastal stock)	6,639	11	4,432	4,443 [d]

Short-finned pilot whale	28,924	0	90	90
Long-finned pilot whale	39,215	0	90	90
Risso's dolphin	35,215	0	270	270
Common dolphin	172,974	0	1,749	1,749
Harbor porpoise	95,543	79	536	615
Gray seal	27,300	35	675	710
Harbor seal	61,336	48	1,775	1,823

a – Listed as Endangered under the Endangered Species Act (ESA).
b – Activities include impact pile driving of WTG and OSS foundations (assuming mitigated by 10 dB), vibratory pile driving for the installation/removal of temporary cofferdams, HRG surveys (year-round with variable levels of effort), and up to 10 potential high-order UXO/MEC detonations (assuming mitigated by 10 dB).
c - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
d - The estimate for coastal bottlenose dolphins (bayside versus Atlantic Ocean-facing) is likely an overestimate as this stock has demonstrated a preference for coastal environments as opposed to estuarine (Toth et al., 2011).

In making the negligible impact determination and the necessary small numbers finding, NMFS assesses the greatest number of proposed take of marine mammals that could occur within any one year, which in the case of this rule is based on the predicted Year 2 for all species, except the coastal stock of bottlenose dolphins, which used the calculated Level A harassment from Year 1 with the calculated Level B harassment from Year 2. In this calculation, the maximum estimated number of Level A harassment takes in any one year is summed with the maximum estimated number of Level B harassment takes in any one year for each species to yield the highest number of estimated take that could occur in any year. We recognize that certain activities could shift within the 5-year effective period of the rule; however, the rule allows for that flexibility and the takes are not expected to exceed those shown in Table 36 in any year.

Table 36 -- Maximum Number Of Requested Takes (Level A Harassment and Level B Harassment) That Could Occur In Any One Year Of The Project And The Total Percent Stock That Would Be Taken Based On The Maximum Annual Requested Take

Marine Mammal Species	Population Size	Maximum Annual Take Authorized			
		Max Level A Harassment	Max Level B Harassment	Max Annual Take (Max Level A Harassment + Max Level B Harassment)	Total Percent Stock Taken Based on Maximum Annual Take [b]
North Atlantic right whale [a]	368	0	7	7	1.90
Blue whale [a]	Unknown [c]	0	4	4	0.97
Fin whale [a]	6,802	4	13	17	0.25
Sei whale [a]	6,292	1	3	4	0.06
Minke whale	21,968	22	74	96	0.44
Humpback whale	1,396	6	21	27	1.93
Sperm whale [a]	4,349	0	6	6	0.14
Atlantic white-sided dolphin	93,233	0	100	100	0.11
Atlantic spotted dolphin	39,921	0	135	135	0.34

Bottlenose dolphin (offshore stock)	62,851	0	1,454	1,454	2.31
Bottlenose dolphin (coastal stock)	6,639	11	1,643	1,645	24.78 [d]
Short-finned pilot whale	28,924	0	30	30	0.10
Long-finned pilot whale	39,215	0	30	30	0.08
Risso's dolphin	35,215	0	90	90	0.26
Common dolphin	172,974	0	1,584	1,584	0.92
Harbor porpoise	95,543	69	350	419	0.44
Gray seal	27,300	31	305	336	1.23
Harbor seal	61,336	35	844	879	1.43

a – Listed as Endangered under the Endangered Species Act (ESA).
b – Calculations of percentage of stock taken are based on the maximum requested Level A harassment take in any one year + the total requested Level B harassment take in any one year and then compared against the best available abundance estimate as shown in Table 3. For this proposed action, the best available abundance estimates are derived from the NMFS Stock Assessment Reports (Hayes et al., 2022).
c - The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination, as shown in parenthesis.
d - The estimate for coastal bottlenose dolphins (bayside versus Atlantic Ocean-facing) is likely an overestimate as this stock has demonstrated a preference for coastal environments as opposed to estuarine (Toth et al., 2011).

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Proposed Mitigation

In order to promulgate a rulemaking under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to the activity, and other means of effecting the least practicable impact on the species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS' regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting the activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned), the likelihood of effective implementation (probability implemented as planned); and,

(2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The mitigation strategies described below are consistent with those required and successfully implemented under previous incidental take authorizations issued in association with in-water construction activities (*i.e.,* ramp-up, establishing harassment zones, implementing shutdown zones, *etc.*). Additional measures have also been incorporated to account for the fact that the proposed construction activities would occur offshore. Modeling was performed to estimate harassment zones, which were used to inform mitigation measures for pile driving activities to minimize Level A harassment and Level B harassment to the extent practicable, while providing estimates of the areas within which Level B harassment might occur.

Generally speaking, the measures considered and proposed here fall into three categories: seasonal-area restrictions, real-time measures (shutdown, clearance zones, and vessel strike avoidance), and noise abatement/reduction measures. Seasonal/Area limitations are designed to avoid or minimize operations in season and/or areas of biological importance (where marine mammals are concentrated or engaged in behaviors that make them more susceptible, or make severe impacts more likely) in order to reduce both the number and severity of potential takes, and are effective in reducing both chronic (longer-term) and acute effects. Real-time measures, such as shutdown and pre-clearance zones, and vessel strike avoidance measures, are intended to reduce the probability or scope of near-term acute impacts by taking steps in real time once a higher-risk scenario is identified (*i.e.,* once animals are detected within an impact zone). Noise abatement measures, such as bubble curtains, are intended to reduce the noise at the source, which reduces both acute impacts, as well as the contribution to aggregate and cumulative noise that results in longer term chronic impacts.

Training and Coordination

Prior to the onset of any in-water activities involving vessel use, pile driving, UXO/MEC detonation, and HRG surveys, and when new personnel join the work, Ocean Wind would conduct briefings for construction supervisors and crews, marine mammal observer and acoustic monitoring teams, and all Ocean Wind staff prior to the start of all pile driving, UXO/MEC detonation, and HRG survey activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, and marine mammal mitigation, monitoring, and reporting requirements. More information on vessel crew training requirements can be found in the *Vessel Strike Avoidance Measures* section below.

North Atlantic Right Whale Awareness Monitoring

Ocean Wind must use available sources of information on North Atlantic right whale presence, including daily monitoring of the Right Whale Sightings Advisory System, monitoring of Coast Guard VHF Channel 16 throughout each day to receive notifications of any sightings, and information associated with any regulatory management actions (*e.g.,* establishment of a zone identifying the need to reduce vessel speeds). Maintaining daily awareness and coordination affords increased protection of North Atlantic right whales by understanding North Atlantic right whale presence in the area through ongoing visual and passive acoustic monitoring efforts and opportunities (outside of Ocean Wind's efforts), and allows for planning of construction activities, when practicable, to minimize potential impacts on North Atlantic right whales.

Protected Species Observers and PAM Operator Training

Ocean Wind would only employ NMFS-approved PSOs and PAM operators. The PSO field team and PAM team will have a lead member (designated as the ''Lead PSO'' or ''PAM Lead'') who will have prior experience observing mysticetes, odontocetes and pinnipeds in the Northwestern Atlantic Ocean on other offshore projects requiring PSOs. Any remaining PSOs and PAM operators must have previous experience observing marine mammals during projects and must have the ability to work with all required and relevant software and equipment. New and/or inexperienced PSOs would be paired with an experienced PSO to ensure that the quality of marine mammal observations and data recording is kept consistent.

All PSOs and PAM operators would be required to complete a Permits and Environmental Compliance Plan (PECP) training, as well as a two-day training and refresher session. These trainings will be held with the PSO provider and Project compliance representatives and will occur before the start of project activities related to the construction and development of the Ocean Wind 1 Offshore Wind Energy Facility. PSOs would be required during all foundation installation, cofferdam installation/removal, UXO/MEC detonation, and HRG surveys. More information on requirements during each activity can be found in the Proposed Monitoring and Reporting section.

Vessel Strike Avoidance Measures

This proposed rule contains numerous vessel strike avoidance measures. Ocean Wind will be required to comply with these measures except under circumstances when doing so would create an imminent and serious threat to a person or vessel, or to the extent that a vessel is unable to maneuver and, because of the inability to maneuver, the vessel cannot comply (*e.g.,* due to towing, *etc.*). Vessel operators and crews will receive protected species identification training. This training will cover sightings of marine mammals and other protected species known to occur or which have the potential to occur in the project area. It will include training on making observations in both good weather conditions (*i.e.,* clear visibility, low wind, and low sea state) and bad weather conditions (*i.e.,* fog, high winds and high sea states, in glare). Training will not only include identification skills, but will also include information and resources available regarding applicable Federal laws and regulations for protected species.

Ocean Wind will abide by the following vessel strike avoidance measures:

• All vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course (as appropriate) and regardless of vessel size, to avoid striking any marine mammal.

• During any vessel transits within or to/from the Ocean Wind project area, such as for crew transfers), an observer would be stationed at the best vantage point of the vessel(s) to ensure that the vessel(s) are maintaining the appropriate separation distance from marine mammals.

• Year-round, all vessel operators will monitor, the project's Situational Awareness System, WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales once every 4-hour shift during project-related activities. The PSO and PAM operator monitoring teams for all activities will also monitor these systems no less than every 12 hours. If a vessel operator is alerted to a North Atlantic right whale detection within the project area, they will immediately convey this information to the PSO and PAM teams. For any UXO/MEC detonation, these systems will be monitored for 24 hours prior to blasting.

• Any observations of any large whale by any Ocean Wind staff or contractor, including vessel crew, must be communicated immediately to PSOs and all vessel captains to increase situational awareness.

• All vessels would comply with existing NMFS regulations and speed restrictions and state regulations as applicable for North Atlantic right whales.

• Between November 1st and April 30th, all vessels, regardless of size, would operate port to port (specifically from ports in New Jersey, New York, Maryland, Delaware, and Virginia) at 10 knots or less.

• All vessels, regardless of size, would immediately reduce speed to 10 kts or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed near (within 500 m) an underway vessel.

• All vessels, regardless of size, would immediately reduce speed to 10 kts or less when a North Atlantic right whale is sighted, at any distance, by an observer or anyone else on the vessel.

• If a vessel is traveling at greater than 10 kts, in addition to the required dedicated visual observer, real-time PAM of transit corridors must be conducted prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kts or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 12 hours.

• All underway vessels (*e.g.,* transiting, surveying) must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this proposed action. Visual observers may be third-party observers (*i.e.,* NMFS-approved PSOs) or crew members and must not have any other duties other than observing for marine mammals. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine mammals. Confirmation of the observers' training and understanding of the ITA requirements must be documented on a training course log sheet and reported to NMFS.

• All vessel operators and crews, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any marine mammal.

• All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action.

• If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kts or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale, or a large whale that cannot be confirmed to species, is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 500 m.

• All vessels must maintain a minimum separation distance of 100 m from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 100 m.

• All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinoid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). Engines will not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m.

• When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area. If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.,* any situation where the vessel is navigationally constrained.

- All vessels underway must not divert or alter course in order to approach any marine mammal. Any vessel underway must avoid excessive speed or abrupt changes in direction.
- For in-water construction heavy machinery activities other than impact or vibratory pile driving, if a marine mammal in on a path towards or comes within 10 m of equipment, Ocean Wind must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment.
- Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. All PSOs will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to the protocol will be coordinated between NMFS and Ocean Wind.

With the measures described herein, NMFS has prescribed the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Fishery Monitoring Surveys

Training

All crew undertaking the fishery survey activities would be required to receive protected species identification training prior to activities occurring.

During Vessel Use

During all fishery monitoring activities that require the use of a vessel as a platform, Ocean Wind would follow the *Vessel Strike Avoidance Measures,* described in the section above.

Vessels would also undertaking the following measures:

- Specifically for trawl surveys, marine mammal monitoring will occur prior to, during, and after haul-back, and gear will not be deployed if a marine mammal is observed in the area;
- Trawl operations will only start after 15 minutes of no marine mammal sightings within 1 nm of the sampling station; and,
- During daytime sampling for the research trawl surveys, Ocean Wind will maintain visual monitoring efforts during the entire period of time that trawl gear is in the water from deployment to retrieval. If a marine mammal is sighted before the gear is removed from the water, the vessel will slow its speed and steer away from the observed animal(s).

Gear-Specific Best Management Practices (BMPs)

Ocean Wind would be required to undertake BMPs to reduce risks to marine mammals during several types of activities. These include:

- BRUV sampling and chevron trap usage, for example, would utilize specific mitigation measures to reduce impacts to marine mammals. These specifically include the breaking strength of all lines being less than 1,700 pounds (771 kg), limited soak durations of 90 minutes or less, no gear being left without a vessel nearby, and a delayed deployment of gear if a marine mammal is sighted nearby;
- The permit number will be written clearly on buoy and any lines that go missing will be reported to NOAA Fisheries' Greater Atlantic Regional Fisheries Office (GARFO) Protected Resources Division as soon as possible;
- If marine mammals are sighed near the proposed sampling location, chevron traps and/or BRUVs will not be deployed;
- If a marine mammal is determined to be at risk of interaction with the deployed gear, all gear will be immediately removed;
- Marine mammal monitoring would occur during daylight hours and begin prior to the deployment of any gear (*e.g.,* trawls, longlines) and continue until all gear has been retrieved;
- If marine mammals are sighted in the vicinity within 15 minutes prior to gear deployment and it is determined the risks of interaction are present regarding the research gear, the sampling station will either move to another location or suspend activities until there are no marine mammal sightings for 15 minutes within 1 nm.

WTG and OSS Foundation Installation

Seasonal and Daily Restrictions

No foundation impact pile driving activities would occur January 1 through April 30. This seasonal restriction would minimize the potential for North Atlantic right whales to be exposed to pile driving noise. Based on the best available information (Roberts *et al.,* 2022), the highest densities of North Atlantic right whales in the project area are expected during the months of January through April. NMFS is requiring this seasonal restriction to minimize the potential for North Atlantic right whales to be exposed to noise incidental to impact pile driving of monopiles, which is expected to greatly reduce the number of takes of North Atlantic right whales.

No more than two foundation monopiles would be installed per day. Monopiles would be no larger than 11-m in diameter, representing the larger end of the tapered 8/11-m monopile design. If jacket foundations are used for OSSs, pin piles would be no larger than 2.44-m in diameter. For all monopiles and pin piles, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,000 kJ.

Ocean Wind has requested authorization to initiate pile driving during nighttime when detection of marine mammals is visually challenging. To date, Ocean Wind has not submitted a plan containing the information necessary, including evidence, that their proposed systems are capable of detecting marine mammals, particularly large whales, at distances necessary to ensure mitigation measures are effective and, in general, the scientific literature on these technologies demonstrate there is a high degree of uncertainty in reliably detecting marine mammals at distances necessary for this project. Therefore, NMFS is not proposing, at this time, to allow Ocean Wind to initiate pile driving later than 1.5 hours after civil sunset or 1 hour before civil sunrise. We are, however, proposing to encourage and allow Ocean Wind the opportunity to further investigate and test advanced technology detection systems to support their request. NMFS is proposing to condition the LOA such that nighttime pile driving would only be allowed if Ocean Wind submits an Alternative Monitoring Plan to NMFS for approval that proves the efficacy of their night vision devices (*e.g.,* mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting protected marine mammals. If the plan does not include a full description of the proposed technology, monitoring methodology, and data supporting that marine mammals can reliably and effectively be detected within the clearance and shutdown zones for monopiles before and during impact pile driving, nighttime pile driving (unless a pile was initiated 1.5 hours prior to civil sunset) will not be allowed. The Plan should identify the efficacy of the technology at detecting marine mammals in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting.

Noise Abatement Systems

Ocean Wind would employ noise abatement systems, also known as noise mitigation systems (NMS), during all impact pile driving (monopiles and pin piles) to reduce the sound pressure levels that are transmitted through the water in an effort to reduce ranges to acoustic thresholds and minimize any acoustic impacts resulting from pile driving. Ocean Wind would be required to employ a big double bubble curtain or a combination of two or more NMS during these activities, as well as the adjustment of operational protocols to minimize noise levels.

Two categories of NMS exist: primary and secondary. A primary NMS would be used to reduce the level of noise produced by the pile driving activities at the source, typically through adjustments on to the equipment (*e.g.,* hammer strike parameters). Primary NMS' are still evolving and will be considered for use during mitigation efforts when the NMS has been demonstrated as effective in commercial projects. However, as primary NMS are not fully effective at eliminating, a secondary NMS would be employed. The secondary NMS is a device or group of devices that would reduce noise as it was transmitted through the water away from the pile, typically through a physical barrier that would reflect or absorb sound waves and, therefore reducing the distance the higher energy sound propagates through the water column. Together, these systems must reduce noise levels to the lowest level practicable with the goal of not exceeding measured ranges to Level A harassment and Level B harassment isopleths corresponding to those modeled assuming 10-dB sound attenuation, pending results of SFV (see the *Acoustic Monitoring for Sound Field and Harassment Isopleth Verification* section).

Noise abatement systems, such as bubble curtains, are sometimes used to decrease the sound levels radiated from a source. Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the bubbles determines their effective frequency band, with larger bubbles needed for lower frequencies. There are a variety of bubble curtain systems, confined or unconfined bubbles, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. Small bubble curtains have been measured to reduce sound levels but effective attenuation is highly dependent on depth of water, current, and configuration and operation of the curtain (Austin *et al.,* 2016; Koschinski and Lüdemann, 2013). Bubble curtains vary in terms of the sizes of the bubbles and those with larger bubbles tend to perform a bit better and more reliably, particularly when deployed with two separate rings (Bellmann, 2014; Koschinski and Lüdemann, 2013; Nehls *et al.,* 2016). Encapsulated bubble systems (*e.g.,* Hydro Sound Dampers (HSDs)), can be effective within their targeted frequency ranges, *e.g.,* 100–800 Hz, and when used in conjunction with a bubble curtain appear to create the greatest attenuation. The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Secondary NMS that must be used by Ocean Wind include a big bubble curtain (BBC), a hydro-sound damper (HSD), or an AdBm Helmholz resonator (Elzinga *et al.,* 2019). See Section 2.8 of the ITA application (Appendix B, Protected Species Mitigation and Monitoring Plan (PSMMP)) for more information on these (Ocean Wind, 2022b). If a single system is used, it must be a double big bubble curtain (DBBC). Other systems (*e.g.,* noise mitigation screens) are not considered feasible for the Ocean Wind 1 project as they are in their early stages of development and field tests to evaluate performance and effectiveness have not been completed. Should the research and development phase of these newer systems demonstrate effectiveness, as part of adaptive management, Ocean Wind may submit data on the effectiveness of these systems and request approval from NMFS to use them during pile driving.

If a bubble curtain is used (single or double), Orsted would be required to maintain the following operational parameters: The bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 m^3/(min*m), and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; no parts of the ring or other objects should prevent full seafloor contact. Ocean Wind must require that construction contractors train personnel in the proper balancing of airflow to the bubble ring, and must require that construction contractors submit an inspection/performance report for approval by Ocean Wind within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving of monopiles. If Ocean Wind uses a noise mitigation device in addition to a BBC, similar quality control measures will be required.

The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Dähne *et al.* (2017) found that single bubble curtains that reduce sound levels by 7 to 10 dB reduced the overall sound level by approximately 12 dB when combined as a double bubble curtain for 6 m steel monopiles in the North Sea. Bellmann *et al.* (2020) provide a review of the efficacy of using bubble curtains (both single and double) as noise abatement systems in the German Exclusive Economic Zone (EEZ) of the North and Baltic Seas. For 8 m diameter monopiles, single bubble curtains achieved an average of 11 dB broadband noise reduction (Bellmann *et al.,* 2020). Ocean Wind would use a combination of two devices during impact pile driving.

As previously discussed, the modeling of the sound fields for Ocean Wind's proposed activities demonstrated modeling assuming broadband attenuation levels of 0 dB, 6 dB, 10 dB, 15 dB, and 20 dB to gauge the effects on the ranges to threshold, given these various levels of sound attenuation. Ocean Wind anticipates, and NMFS agrees, that the use of a noise mitigation system will produce field measurements of the isopleth distances to the Level A harassment and Level B harassment thresholds that accord with those modeled assuming 10 dB of attenuation for both impact pile driving of monopiles and pin piles (refer back to the Estimated Take, Proposed Mitigation, and Proposed Monitoring and Reporting sections).

Use of PSOs and PAM Operators

As described above, Ocean Wind would be required to use PSOs and acoustic PSOs (*i.e.,* PAM operator) during all foundation installation activities. At minimum, four PSOs would be actively observing marine mammals before, during, and after pile driving. At least two PSOs would be stationed on the pile driving vessel and at least two PSOS would be stationed on a secondary, PSO-dedicated vessel. The dedicated PSO vessel would be located at the outer edge of the 2 km (in the summer; 2.5 km in the winter) large whale clearance zone (unless modified by NMFS based on SFV). These PSOs would be required to maintain watch at all times when impact pile driving of monopiles and/or pin piles is underway. Concurrently, at least one PAM operator would be actively monitoring for marine mammals before, during and after pile driving. More details on PSO and PAM operator requirements can be found in the Proposed Monitoring and Reporting section.

Furthermore, all crew and personnel working on the Ocean Wind 1 project would be required to maintain situational awareness of marine mammal presence (discussed further above) and would be required to report any sightings to the PSOs.

Clearance and Shutdown Zones

NMFS is proposing to require the establishment of both clearance and shutdown zones during all impact pile driving of WTG and OSS foundation piles. Ocean Wind must use visual PSOs and PAM operators to monitor the area around each foundation pile before, during and after pile driving. Prior to the start of impact pile driving activities, Ocean Wind would clear the area of marine mammals, per Table 37, to minimize the potential for and degree of harassment.

The purpose of ''clearance'' of a particular zone is to prevent potential instances of auditory injury, and more severe behavioral disturbance or, in the case of North Atlantic right whales, avoid and minimize behavioral disturbance to the maximum extent practicable (for North Atlantic right whales, the clearance and shutdown zones are set to any distance; see Table 37). By delaying the commencement of impact pile driving if marine mammals are detected within certain pre-defined distances from the pile being installed.

PSOs would visually monitor for marine mammals for a minimum of 60 minutes while PAM operators would review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes immediately prior to starting a soft-start of pile driving. If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and will not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species).

All distances to the perimeter of clearance zones are the radii from the center of the pile.

Mitigation zones related to impact pile driving activities were created around two different seasonal periods to account for the different seasonal sound speed profiles that were used in JASCO's underwater sound propagation modeling, including summer (May through November) and winter (December) (Table 37). Ocean Wind would be required to implement these zones during foundation installation. While clearance and shutdowns would be monitored both visually and acoustically, NMFS is proposing to establish a minimum visibility zone close to the piles to ensure that marine mammals are detected prior to commencement of pile driving as visual and acoustic methods provide the most effective means of detection when combined (*e.g.,* VanParijs *et al.,* 2021). The minimum visibility zone would extend 1,650 m from the pile during summer months and 2,500 m during December (Table 37). These values correspond to the maximum LFC distance to Level A harassment thresholds assuming two monopiles are driven in a day. The entire minimum visibility zone must be visible (*i.e.,* not obscured by dark, rain, fog, *etc.*) for a full 30 minutes immediately prior to commencing impact pile driving. For North Atlantic right whales, there is an additional requirement that the clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred during the 60-minute monitoring period. Any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale.

The purpose of a shutdown is to prevent a specific acute impact, such as auditory injury or severe behavioral disturbance of sensitive species, by halting the activity. If a marine mammal is observed entering or within the respective shutdown zone (Table 37) after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving. In situations when shutdown is called for but Ocean Wind determines shutdown is not practicable due to 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 must be implemented when the lead engineer determines it is practicable. Specifically, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal, and a shut-down would lead to a stuck pile which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. Pile instability occurs when the pile is unstable and unable to stay standing if the piling vessel were to ''let go.'' During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shut-down combined with impending weather conditions may require the piling vessel to ''let go'' which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals.

After shutdown, impact pile driving may be reinitiated once all clearance zones are clear of marine mammals for the minimum species-specific periods, or, if required to maintain pile stability, at which time the lowest hammer energy must be used to maintain stability. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection. Upon re-starting pile driving, soft start protocols must be followed.

The clearance and shutdown zone sizes vary by species and are shown in Table 37. Ocean Wind would be allowed to request modification to these zone sizes pending results of sound field verification (see Proposed Monitoring and Reporting section). Any changes to zone size would be part of adaptive management and would require NMFS' approval.

Table 37 -- Clearance and Shutdown Zones During Impact Pile Driving In Summer And Winter

Monitoring details	Zone Sizes for Impact Piling [a]				
	North Atlantic right whales	Large whales	Delphinids	Harbor porpoises	Seals
Minimum Visibility Zone	1,650 m (2,500 m)				
Clearance Zone	any distance	2,000 m (2,500 m)	100 m	1,100 m (1,450 m)	100 m
PAM Clearance Zone	3,500 m (3,800 m)	n/a	n/a	n/a	n/a
Shutdown Zone	any distance	1,800 m (2,500 m)	100 m	1,000 m (1,450 m)	100 m
PAM Shutdown Zone	1,650 m (2,500 m)	n/a	n/a	n/a	n/a

a - Winter (i.e., December) distances are presented in parentheses.

Soft-Start

The use of a soft start procedure is believed to provide additional protection to marine mammals by warning them, or providing them with a chance to leave the area prior to the hammer operating at full capacity. Soft start typically involves initiating hammer operation at a reduced energy level (relative to full operating capacity) followed by a waiting period. Ocean Wind must utilize a soft start protocol for impact pile driving of monopiles by performing 4–6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes. NMFS notes that it is difficult to specify a reduction in energy for any given hammer because of variation across drivers. For impact hammers, the actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in ‘‘bouncing’’ of the hammer as it strikes the pile, resulting in multiple ‘‘strikes’’; however, as mentioned previously, Ocean Wind will target less than 20 percent of the total hammer energy for the initial hammer strikes during soft start. Soft start will be required at the beginning of each day's monopile installation, and at any time following a cessation of impact pile driving of 30 minutes or longer. If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving would be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species).

Cofferdam Installation and Removal

Seasonal and Daily Restrictions

Ocean Wind has proposed to construct the cofferdams from October to May within the first year of the effective period of the regulations and LOA, with some potential removal being necessary in April or May. However, NMFS is not requiring any seasonal restrictions in this proposed rule due to the relatively short duration of work (*i.e.,* low associated impacts) and although North Atlantic right whales do migrate in coastal waters, they do not typically migrate very close to shore off of New Jersey and/or within New Jersey bays where work would be occurring. Given the distance to the Level B harassment isopleth is conservatively modeled at approximately 10 km, any exposure to vibratory pile driving during cofferdam installation would be at levels closer to the 120 dB Level B harassment threshold and not at louder source levels. Ocean Wind would be required; however, to conduct vibratory pile driving associated with cofferdam installation during daylight hours only.

Noise Abatement Systems

Ocean Wind would install the cofferdams using vibratory pile driving. Given this and the short duration of work, NMFS is not proposing to require noise abatement systems during this activity.

Passive Acoustic Monitoring

PAM would not be required during the installation or removal of temporary cofferdams.

Clearance and Shutdown Zones

Ocean Wind would establish clearance and shutdown zones for vibratory pile driving activities associated with cofferdam installation (Table 38). Prior to the start of vibratory pile driving activities, at least two PSOs will monitor the clearance zone for 30 minutes, continue monitoring during pile driving and for 30 minutes post pile driving. If a marine mammal is observed entering or is observed within the respective zones, piling will not commence or will be delayed until the animal has exited the zone or a specific amount of time has elapsed since the last sighting (*i.e.,* 30 minutes for large whales and 15 minutes for dolphins, porpoises, and pinnipeds). If a marine mammal is observed entering or within the respective shutdown zone after vibratory pile driving has begun, the PSO will call for a temporary cessation of vibratory pile driving. Ocean Wind must immediately cease pile driving upon orders of the PSO unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species). Because a vibratory hammer can grip a pile without operating, pile instability should not be a concern and no caveat for re-starting pile driving due to pile instability is proposed.

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Table 38 -- Distances to Harassment Thresholds and Mitigation Zones[1] During Vibratory Sheet Pile Driving

Marine Mammal Species	Level A harassment (SEL_{cum}) (m)	Level B harassment (m)	Clearance Zone[2] (m)	Shutdown Zone[3] (m)
Low-frequency cetaceans				
Fin whale*	86.7	10,000	150	100
Minke whale	86.7	10,000	150	100
Sei whale*	86.7	10,000	150	100
Humpback whale	86.7	10,000	150	100
North Atlantic right whale*	86.7	10,000	150	100
Blue whale*	86.7	10,000	150	100
Mid-frequency cetaceans				
Sperm whale*	7.7	10,000	150	100
Atlantic white-sided dolphin	7.7	10,000	150	50
Atlantic spotted dolphin	7.7	10,000	150	50
Common dolphin	7.7	10,000	150	50
Risso's dolphin	7.7	10,000	150	50
Bottlenose dolphin (offshore stock)	7.7	10,000	150	50
Bottlenose dolphin (coastal stock)	7.7	10,000	150	50
Long-finned pilot whale	7.7	10,000	150	50
Short-finned pilot whale	7.7	10,000	150	50

High-frequency cetaceans				
Harbor porpoise	128.2	10,000	150	150
Phocid Pinnipeds (in water)				
Gray seal	52.7	10,000	150	60
Harbor seal	52.7	10,000	150	60

* = denotes species listed under the Endangered Species Act.
Note: SEL_{cum} = cumulative sound exposure level; SPL_{pk} = peak sound pressure level.
1 - Zone sizes are based upon a practical spreading loss model and a source level of 165.0 dB re 1 μPa (JASCO, 2021).
2 - The clearance zones for large whales, porpoises, and seals are based upon the maximum Level A harassment zone (128.2 m) and rounded up for PSO clarity.
3 - The shutdown zones for large whales (including North Atlantic right whale) and porpoises are based upon the maximum Level A harassment zone for each group and rounded up for PSO clarity. Shutdown zones for other dolphins and pilot whales were set using precautionary distances.

UXO/MEC Detonations

While there would be no more than 10 detonations of UXOs/MECs, and these detonations are of very short duration (approximately 1 second), UXO/MEC detonations have a higher potential to cause mortality and injury than other activities proposed by Ocean Wind, and therefore have specific mitigation measures designed to minimize the likelihood of mortality and/or injury of marine mammals, including: (1) time of year/seasonal restrictions; (2) time of day restrictions; (3) use of PSOs to visually observe for North Atlantic right whales; (4) use of PAM to acoustically detect North Atlantic right whales; (5) implementation of clearance zones; (6) use of noise mitigation technology; and, (7) post-detonation monitoring visual and acoustic monitoring by PSOs and PAM operators.

As Low as Reasonably Practicable (ALARP) Approach

For any UXOs/MECs that require removal, Ocean Wind would be required to implement the As Low as Reasonably Practicable (ALARP) process. This process would require Ocean Wind to undertake ''life-and-shift'', *i.e.,* physical removal and then lead up to in situ disposal, which would include low-order (deflagration) to high-order (detonation) methods of removal. Other approaches involve the cutting of the UXO/MEC to extract any explosive components. Implementing the ALARP approach would minimize potential impacts to marine mammals as UXOs/MECs would only be detonated as a last resort.

Seasonal and Daily Restrictions

There is no specific time of year that UXOs/MECs would be detonated as detonation would be considered on a case-by-case basis. However, Ocean Wind would be limited to detonating UXOs/MECs only between May 1st through October 31st to reduce impacts to North Atlantic right whales during peak migratory periods. Furthermore, UXO/MEC detonation would be limited to daylight hours only to reduce impacts on migrating species (such as North Atlantic right whales) and to ensure that visual PSOs can confirm appropriate clearance of the site prior to detonation events occurring.

Noise Abatement Systems

Ocean Wind would be required to use a dual noise abatement system during all UXO/MEC detonation events, as detonations are determined to be necessary during the construction. Although the exact level of noise attenuation that can be achieved by noise abatement systems is unknown, available data from Bellmann *et al.* (2020) and Bellmann and Betke (2021) provide a reasonable expectation that the noise abatement systems will be able to achieve at least 10 dB attenuation. SFV would be required for all detonation events to verify the modeled distances, assuming 10 dB attenuation, are representative of the sound fields generated during detonations. This level of noise reduction is substantial in reducing impact zones for low-frequency cetaceans such as the North Atlantic right whale. For example, assuming the largest UXO/MEC charge weight (454 kg; E12) at a depth of 45 m, a 10 dB reduces the Level A harassment isopleth from 229 km² to approximately 41 km² (Table 6–4 in the ITA application). The Level B harassment zone, given the same parameters, would decrease from 1,134 km² to 437 km² (Table 6–5 in the ITA application). However, and as previously stated in this document, Ocean Wind does not expect that all ten of the potential UXOs/MECs would constitute the largest charge weight; however, this weight was used as a conservative option in estimating exposures and take of marine mammals.

Use of PSOs and PAM Operators

Clearing the zone would require use of at least six visual PSOs and one PAM operator on at least two dedicated PSO vessels. An aerial survey must also be performed prior to detonation and immediately after detonation to monitor for marine mammals. This zone must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes prior to detonation. PAM must also be conducted for at least 60 minutes and the zone must be acoustically cleared during this time.

Clearance Zones

Prior to any detonation activities, Ocean Wind proposed to clear a zone encompassing a radius of 3.78 km around the detonation site using both visual and acoustic monitoring methods. This distance represents the modeled Level A (PTS) harassment threshold for low-frequency cetaceans (*i.e.,* large whales) rounded up to the nearest km assuming a 454 kg charge weight and use of a bubble curtain (Table 39). However, NMFS is proposing to require more protective zone sizes in order to ensure the least practicable adverse impact which includes minimizing the potential for TTS. It is currently not known how easily Ocean Wind will be able to identify UXO/MEC size in the field. For this reason, NMFS proposes to require Ocean Wind to clear a zone extending 10 km for large whales, 2 km for dolphins, 10 km for harbor porpoises, and 5 km for seals (Table 39). These zones are based on (but not equal to) the greatest TTS threshold distances from 454 kg charge at any site modeled. We note that harbor porpoise and seals are difficult to detect at great distances, but due to the UXO/MEC detonation time of year restrictions, their presence/abundance is likely to be relatively low. These zone sizes may be adjusted based on SFV and confirmation of UXO/donor charge sizes. Moreover, if Ocean Wind indicates to NMFS they will be able to easily identify charge weights in the field, NMFS would develop clearance zones in the final rule for each charge weight analyzed. The zones would be based on Table 39 below.

If a marine mammal is observed entering or within the clearance zone prior to denotation, the activity would be delayed. Only when the marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales (including the North Atlantic right whale) or 15 minutes have elapsed without any redetections of delphinids, harbor porpoises, or seals may detonation continue.

Table 39 -- Largest Modeled Clearance and Harassment Zones during UXO/MEC Detonation of E12 (454 kg) Charges Assuming 10 dB Noise Abatement

Marine Mammal Species		Distances to Zones for E12 (454 kg) UXO/MEC Charge Weight[1]		
		Level A Harassment Clearance zone (m)	Level B Harassment Zone (m)	Clearance Zones
Low-frequency cetaceans				
Fin whale*		3,780	11,900	10,000
Minke whale				
Sei whale*				
Humpback whale				
North Atlantic right whale*				
Blue whale*				
Mid-frequency cetaceans				
Sperm whale*		461	2,550	2,000
Atlantic white-sided dolphin				
Atlantic spotted dolphin				
Common dolphin (short-beaked)				
Risso's dolphin				
Bottlenose dolphin	Coastal			
	Offshore			
Long-finned pilot whale				
Short-finned pilot whale				
High-frequency cetaceans				

Harbor porpoise	6,200	14,100	10,000
Pinnipeds (in water)			
Gray seal	1,600	7,020	5,000
Harbor seal			

* = denotes species listed under the Endangered Species Act; kg = kilograms; m = meters; PK = peak pressure level; SEL = sound exposure level.

1 - At time of preparing this proposed rule, Ocean Wind has not provided NMFS evidence they will be able to reliably determine the charge weight of any UXO/MEC that must be detonated; therefore, NMFS assumes all UXO/MECs could be of the largest size modeled. If Ocean Wind provides information they can detect charge weights in the field prior to issuance of the final rule, if issued, NMFS may modify the clearance zone to ones based on charge weights distances to PTS and TTS. Distances to PTS and TTS thresholds have been identified by Ocean Wind in Appendix C of their application.

HRG Surveys

Ocean Wind would be required to implement several mitigation measures during all HRG survey activities using boomers, sparkers, and CHIRPs. The measures include shutdown, clearance, ramp-up, the use of PSOs, and vessel strike avoidance. There are no mitigation measures prescribed for sound sources greater than 180 kHz as these would be expected to fall outside of marine mammal hearing ranges and not result in harassment; however, all HRG survey vessels would be subject to the aforementioned vessel strike avoidance measures described earlier in this section. Furthermore, due to the frequency range and characteristics of some of the sound sources, shutdown, clearance, and ramp-up procedures are not proposed to be conducted during HRG surveys utilizing only non-impulsive sources (*e.g.,* Ultra-Short BaseLine and other parametric sub-bottom profilers), with exception to usage of CHIRPS and other non-parametric sub-bottom profilers.

Seasonal and Daily Restrictions

Given the potential impacts to marine mammals from exposure to HRG survey noise sources are relatively minor (*e.g.,* limited to Level B harassment) and that the distances to the Level B harassment isopleth is very small (maximum distance is 141 m), NMFS is not proposing to implement any seasonal or time-of-day restrictions for HRG surveys.

Although no temporal restrictions are proposed, NMFS would require Ocean Wind to deactivate acoustic sources during periods where no data is being collected, except as determined necessary for testing. Any unnecessary use of the acoustic source would be avoided.

Use of PSOs

Ocean Wind would be required to employ qualified, NMFS-approved PSOs during site characterization surveys related to the Ocean Wind 1 project. One PSO would be required to monitor during daylight hours and two would be required to monitor during nighttime hours, per vessel. Any PSO would have the authority to call for a delay or shutdown of survey activities. PSOs would begin visually monitoring 30 minutes prior to the initiation of the specified acoustic source (*i.e.,* ramp-up, if applicable) through 30 minutes after the use of the specified acoustic source has ceased. PSOs would be required to establish and monitor the appropriate clearance and shutdown zones. These zones would be based around the radial distance from the acoustic source and not from the vessel.

Ocean Wind would be required to instruct all vessel personnel regarding the authority of the marine mammal monitoring team(s). For example, the vessel operator(s) would be required to immediately comply with any call for a shutdown by the Lead PSO. Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred. All relevant vessel personnel and the marine mammal monitoring team would be required to participate in joint, onboard briefings that would be led by the vessel operator and the Lead PSO, prior to the beginning of survey activities. This would serve to ensure that all relevant responsibilities, communication procedures, marine mammal monitoring protocols, safety, operational procedures, and ITA requirements are clearly understood by all involved parties. The briefing would be repeated whenever new relevant personnel (*e.g.,* new PSOs, acoustic source operators, relevant crew) join the survey operation before work commences.

Passive Acoustic Monitoring

PAM would not be required during HRG surveys. While NMFS agrees that PAM can be an important tool for augmenting detection capabilities in certain circumstances, its utility in further reducing impacts during HRG survey activities is limited. We have provided a thorough description of our reasoning for not requiring PAM during HRG surveys in several **Federal Register** notices (*e.g.,* 87 FR 40796, July 8, 2022; 87 FR 52913, August 3, 2022; 87 FR 51356, August 22, 2022) which we adopt and those reasons continue to apply for this proposed action.

Clearance, Shutdown, and Vessel Separation Zones

Ocean Wind would be required to implement a 30-minute clearance period of the clearance zones (Table 40) immediately prior to the commencing of the survey or when there is more than a 30 minute break in survey activities and PSOs are not actively monitoring. The clearance zones would be monitored by PSOs, using the appropriate visual technology. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up (as described further on) would not be allowed to begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species). In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (*i.e.,* no delay is required) despite periods of inclement weather and/or loss of daylight.

Once the survey has commenced, Ocean Wind would be required to shut down boomers, sparkers, and CHIRPs if a marine mammal enters a respective shutdown zone (Table 40). In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.,* no shutdown is required) so long as no marine mammals have been detected. The use of boomers, and sparkers, and CHIRPS would not be allowed to commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting. Any large whale sighted by a PSO within 1,000 m of the boomers, sparkers, and CHIRPs that cannot be identified as a non-North Atlantic right whale would be treated as if it were a North Atlantic right whale.

Ocean Wind would be required to immediately shut down any boomer, sparker, or CHIRP sources if a marine mammal(s) is sighted entering or within its respective shutdown zone:

- A 500 m zone for the North Atlantic right whale; and,
- A 100 m zone for all other marine mammal species (with exception of specific delphinid species).

The shutdown requirement would be waived for small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus,* and *Tursiops.* Specifically, if a delphinid from the specified genera is visually detected approaching the vessel (*i.e.,* to bow-ride) or towed equipment, shutdown would not be required. Furthermore, 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), the PSOs would use their best professional judgment in making the decision to call for a shutdown. Additionally, shutdown is required if a delphinid that belongs to a genus other than those specified is detected in the shutdown zone.

If a boomer, sparker, or CHIRP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if: (1) PSOs have maintained constant observation and (2) no additional detections of any marine mammal occurred within the respective shutdown zones. If a boomer, sparker, or CHIRP was shut down for a period longer than 30 minutes, then all clearance and ramp-up procedures would be required to be initiated, as previously described.

Table 40 -- Harassment Threshold Ranges and Mitigation Zones During HRG Surveys

Marine Mammal Species	Level B Harassment Zone (m)		Clearance Zone (m)	Shutdown Zone (m)
	Boomer/Sparker use	CHIRPs		
Low-frequency cetaceans				
Fin whale*	141	48	100	100
Minke whale			100	100
Sei whale*			100	100
Humpback whale			100	100
North Atlantic right whale*			500	500
Blue whale*			100	100
Mid-frequency cetaceans				
Sperm whale*	141	48	100	100
Atlantic white-sided dolphin			100	n/a
Atlantic spotted dolphin			100	n/a
Common dolphin			100	n/a
Risso's dolphin			100	100
Bottlenose dolphin (offshore stock)			100	n/a
Bottlenose dolphin (coastal stock)			100	n/a

Long-finned pilot whale			100	100
Short-finned pilot whale			100	100
High-frequency cetaceans				
Harbor porpoise	141	48	100	199
Phocid Pinnipeds (in water)				
Gray seal	141	48	100	100
Harbor seal				

Note: n/a = no shutdown zone mitigation will be applied
* = species is listed under the Endangered Species Act.

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Ocean Wind to deactivate acoustic sources during periods where no data is being collected, except as determined necessary for testing. Any unnecessary use of the acoustic source would be avoided.

Ramp-Up

At the start or restart of the use of boomers, sparkers, and/or CHIRPs, a ramp-up procedure would be required unless the equipment operates on a binary on/off switch. A ramp-up procedure, involving a gradual increase in source level output, is required at all times as part of the activation of the acoustic source when technically feasible. Operators should ramp up sources to half power for 5 minutes and then proceed to full power. Prior to a ramp-up procedure starting, the operator would have to notify a PSO of the planned start of the ramp-up. This notification time would not be less than 60 minutes prior to the planned ramp-up activities as all relevant PSOs would need the appropriate 30 minute period to monitor prior to the initiation of ramp-up. Prior to ramp-up beginning, the operator must receive confirmation from the PSO that the clearance zone is clear of any marine mammals. All ramp-ups would be scheduled to minimize the overall time spent with the source being activated. The ramp-up procedure must be used at the beginning of construction survey activities or after more than a 30-minute break in survey activities using the specified HRG equipment to provide additional protection to marine mammals in or near the survey area by allowing them to vacate the area prior to operation of survey equipment at full power.

Ocean Wind would not initiate ramp-up until the clearance process has been completed (see Clearance and Shutdown Zones section above). Ramp-up activities would be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up would only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until additional time has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures would provide the means affecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to promulgate a rulemaking for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.,* presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving or feeding areas).
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or

cumulative impacts from multiple stressors.

- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.
- Effects on marine mammal habitat (*e.g.,* marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

Separately, monitoring is also regularly used to support mitigation implementation, which is referred to as mitigation monitoring, and monitoring plans typically include measures that both support mitigation implementation and increase our understanding of the impacts of the activity on marine mammals.

During the construction activities related to Ocean Wind 1, visual monitoring by NMFS-approved PSOs would be conducted before, during, and after impact pile driving; vibratory pile driving; any UXO/MEC detonations, and during HRG surveys, and PAM will be conducted during all impact pile driving and UXO/MEC detonations. Observations by PSOs will support the mitigation measures described above. Also, to increase understanding of the impacts of the activity on marine mammals, observers will record all incidents of marine mammal occurrence at any distance from the piling location, UXO/MEC detonation site, and during active HRG acoustic sources, and monitors will document all behaviors, and behavioral changes, in concert with distance from an acoustic source. The required monitoring is described below, beginning with PSO measures that are applicable to all activities or monitoring, followed by activity-specific monitoring requirements.

Protected Species Observer Requirements

Ocean Wind would be required to collect sighting data and behavioral response data related to construction activities for marine mammal species observed in the region of the activity during the period in which an activity occurs using NMFS-approved visual and acoustic PSOs (see Proposed Mitigation section). All observers must be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. PSOs will monitor all clearance and shutdown zones prior to, during, and following impact pile driving; vibratory pile driving; UXO/MEC detonation; and during HRG surveys using boomers, sparkers, and CHIRPs (with monitoring durations specified further below). PSOs will also monitor the Level B harassment zones and will document any marine mammals observed within these zones, to the extent practicable (noting that some zones are too large to fully observe). Observers would be located at the best practicable vantage points on the pile driving vessel and, where required, dedicated PSO vessels or aerial platforms. Full details regarding all marine mammal monitoring must be included in relevant Plans (*e.g.,* Pile Driving and Marine Mammal Monitoring Plan) that, under this proposed action, Ocean Wind would be required to submit to NMFS for approval at least 90 days in advance of the commencement of any construction activities.

The following measures apply to all visual monitoring efforts:

1. Monitoring must be conducted by qualified, trained PSOs who will be placed on the primary vessel relevant to the activity (*e.g.,* pile driving vessel, UXO/MEC vessel, HRG survey vessel) and dedicated PSO vessels (*e.g.,* additional UXO/MEC vessels) and must be in positions that allow for the best vantage point to monitor for marine mammals and implement the relevant shutdown procedures, when determine to be applicable;

2. PSO must be independent, dedicated, and qualified, meaning that they must be employed by a third-party observer provider and must have no other tasks beyond to conduct observational effort, collect data, and communicate with an instruct the relevant vessel crew with regard to the presence of protected species and mitigation requirements;

3. During all activities, PSOs would be located at the best vantage point(s) to provide adequate coverage of the entire visual shutdown and clearance zones, and as much of the Level B harassment zone as possible, while still maintaining a safe work environment;

4. PSOs may not exceed 4 consecutive watch hours, must have a minimum 2-hour break between watches, and may not exceed a combined watch schedule of more than 12 hours in a single 24-hour period;

5. During all observation periods related to pile driving (impact and vibratory), and UXO/MEC detonations, PSOs would be required to use high-magnification (25x), as well as standard handheld (7x), binoculars and the naked eyes to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, poor weather conditions, *etc.*), PSOs would be required to use alternative technologies (*i.e.,* infrared or thermal cameras) to monitor the shutdown and clearance zones. At least one PSO located on the foundation pile driving vessel and UXO/MEC monitoring vessel would be equipped with ''Big Eye'' binoculars (*e.g.,* 25 × 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality. These would be mounted on a pedestal on the deck of the vessel at the most appropriate vantage point that would provide for the optimal sea surface observation, as well as safety of the PSO;

6. PSOs should have the following minimum qualifications:

a. Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with the ability to estimate the target size and distance. The use of binoculars is permitted and may be necessary to correctly identify the target(s);

b. Ability to conduct field observations and collect data according to the assigned protocols;

c. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;

d. Writing skills sufficient to document observations, including but not limited to: the number and species of marine mammals observed, the dates and times of when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior;

e. Ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area, as necessary.

Observer teams employed by Ocean Wind, in satisfaction of the mitigation and monitoring requirements described herein, must meet the following additional requirements:

1. At least one observer must have prior experience working as an observer;

2. Other observers may substitute education (a degree in biological science or a related field) or training for experience;

3. One observer will be designated as lead observer or monitoring coordinator (''Lead PSO''). This Lead PSO would have prior experience working as an observer in an offshore environment;

4. At least two PSOs located on platforms (either vessel-based or aerial)

would be required to have a minimum of 90 days of at-sea experience working in those roles in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience; and,

5. All PSOs must be approved by NMFS. Ocean Wind would be required to submit the curriculum vitae (CV) of the initial set of PSOs necessary to commence the project to NMFS OPR (at *itp.potlock@noaa.gov*) for approval at least 60 days prior to the first day of construction activities. PSO resumes would need to include the dates of training and any prior NMFS approval, as well as the dates and description of their last PSO experience, and must be accompanied by information documenting their successful completion of an acceptable training course. NMFS would allow for 3 weeks to approve PSOs from the time that the necessary information is received by NMFS, after which any PSOs that meet the minimum requirements would automatically be considered approved.

Some activities planned to be undertaken by Ocean Wind may require the use of PAM, which would necessitate the employment of at least one acoustic PSO (aka PAM operator on duty at any given time). PAM operators would be required to meet several of the specified requirements described above for PSOs, including: 2, 6b–e, 8, 10, and 11. Furthermore, PAM operators would be required to complete a specialized training for operating the PAM systems and must demonstrate familiarity with the PAM system on which they will be working.

PSOs would be able to act as both acoustic and visual observers during the construction of Ocean Wind 1 if the individual(s) demonstrates that they have had the required level and appropriate training and experience to perform each task. However, a single individual would not be allowed to concurrently act in both roles.

Ocean Wind would be required to conduct briefings between construction supervisors, construction crews, and the PSO/PAM team prior to the start of all construction activities. When new personnel join the work, briefings must be held to explain all responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures. An informal guide must be included with the Marine Mammal Monitoring Plan to aid in identifying species if they are observed in the vicinity of the project area.

Ocean Wind's personnel and PSOs would also be required to use available sources of information on North Atlantic right whale presence to aid in monitoring efforts. This includes:

1. Monitoring daily of the Right Whale Sightings Advisory System;

2. Consulting of the WhaleAlert app; and,

3. Monitoring of the Coast Guard's VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas, to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with North Atlantic right whales.

Additionally, whenever multiple project-associated vessels (of any size; *e.g.,* construction survey, crew transfer) are operating concurrently, any visual observations of ESA-listed marine mammals must be communicated to PSOs and vessel captains associated with other vessels to increase situational awareness.

The following are proposed monitoring and reporting measures that NMFS would require specific to each construction activity:

WTG and OSS Foundation Installation

Ocean Wind would be required to implement the following monitoring procedures during all impact pile driving activities of monopiles and/or pin piles related to WTG and OSS installation.

Ocean Wind would be required to have a minimum of four PSOs actively observing marine mammals before, during, and after (specific times described below) the installation of foundation piles (monopiles and/or pin piles). At least four PSOs must be actively observing for marine mammals. At least two PSOs must be actively observing on the pile driving vessel while at least two PSOs are actively observing on a secondary, PSO-dedicated vessel. At least one active PSO on each platform must have a minimum of 90 days at-sea experience working in those roles in offshore environments with no more than 18 months elapsed since the conclusion of the at-sea experience. Concurrently, at least one acoustic PSO (*i.e.,* passive acoustic monitoring (PAM) operator) must be actively monitoring for marine mammals before, during and after impact pile driving.

All PSOs would need to be located at the best vantage point(s) on the impact pile driving vessel and dedicated PSO vessels in order to ensure 360° visual coverage of the entire clearance and shutdown zones around the vessels, and as much of the Level B harassment zone as possible. During all observation periods associated with impact pile driving, PSOs would use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. At least one PSO on the foundation pile driving vessel must be equipped with Big Eye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality. These must be pedestal mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation and PSO safety. As described in the Proposed Mitigation section, if the minimum visibility zone cannot be visually monitored at all times using this or alternative equipment, pile driving operations may not commence or, if active, must shutdown. To supplement visual observers within the applicable shutdown zones, Ocean Wind would utilize at least one PAM operator before, during, and after pile installation. This PAM operator would assist the PSOs in ensuring full coverage of the clearance and shutdown zones. All on-duty visual PSOs will remain in contact with the PAM operator on-duty, who will monitor the PAM systems for acoustic detections of marine mammals in the area. The use of real-time PAM will require at least one PAM operator to monitor each system by viewing the data/data products that would be streamed in real-time or near real-time to a computer workstation and monitor. In some cases, the PAM operator may be located onshore with the workstation and monitor or they may be located on a vessel. In either situation, PAM operators will maintain constant and clear communications with visual PSOs on duty regarding animal detections that would be approaching or found within the applicable zones related to impact pile driving. Ocean Wind would utilize PAM to acoustically monitor the clearance and shutdown zones, and would record all detections of marine mammals and estimated distance (noting whether they are in the Level A harassment or Level B harassment zones). To effectively utilize PAM, Ocean Wind would implement the following protocols:

- PAM operators would be stationed on at least one of the dedicated monitoring vessels in addition to the PSOs; or located remotely/onshore.
- PAM operators would have completed specialized training for operating PAM systems prior to the start of monitoring activities.
- All on-duty PSOs will be in contact with the PAM operator on-duty, who will monitor the PAM systems for

acoustic detections of marine mammals that are vocalizing in the area.

- For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore.
- The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.,* Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures.
- Acoustic monitoring during nighttime and low visibility conditions during the day will complement visual monitoring (*e.g.,* PSOs and thermal cameras) and will cover an area of at least the Level B harassment zone around each foundation.

All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to any impact pile driving, during, and after for 30 minutes. As described in the Proposed Mitigation section, in addition to the clearance zones which can be both visually and acoustically cleared, PSOs would need to visually clear an area extending 1.65 km from the pile during summer months and 2.5 km during December prior to any impact pile driving activities occurring. During this period, marine mammals must be able to be visually detected within the entire minimum visibility zone for a full 30 minutes immediately prior to the start of impact pile driving. The impact pile driving of both monopiles and/or pin piles would only be able to commence when the minimum visibility zone is fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of impact pile driving.

For North Atlantic right whales, any visual or acoustic detection would trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale species, it must be treated as if it were a North Atlantic right whale. Following a shutdown, monopile and/or pin pile installation may not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes.

Cofferdam Installation and Removal

Ocean Wind would be required to implement the following procedures during all vibratory pile driving activities on sheet piles associated with cofferdam installation and removal.

Ocean Wind would be required to have a minimum of two PSOs on active duty during any installation and removal of the temporary cofferdams. These PSOs would always be located at the best vantage point(s) on the vibratory pile driving platform or secondary platform in the immediate vicinity of the vibratory pile driving platform, in order to ensure that appropriate visual coverage is available of the entire visual clearance zone and as much of the Level B harassment zone, as possible. NMFS would not require the use of PAM during vibratory pile driving activities related to the installation or removal of the temporary cofferdam.

PSOs will monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles (and casing pipe, if installed), and for 30 minutes after all vibratory pile driving activities have ceased. Sheet pile or casing pipe installation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving.

During all observation periods related to vibratory pile driving, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* IR/Thermal camera) to monitor clearance and shutdown zones.

UXO/MEC Detonations

Ocean Wind would be required to implement the following procedures during all UXO/MEC detonations.

Ocean Wind would be required to use a minimum of six PSOs and one PAM operator located on at least two dedicated PSO vessels. All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to the UXO/MEC detonation event, during the event, and after for 30 minutes. As UXO/MEC detonation would only occur during daylight hours, PSOs would only need to monitor during daylight hours (*i.e.,* period between civil twilight rise and set).

Ocean Wind would be required to utilize a PAM operator at least 60 minutes prior to detonation events to monitor for marine mammals prior to and after detonation events. The PAM operator would be stationed on one of the dedicated monitoring vessels but may also be located remotely on-shore, but this is subject to approval by NMFS. When real-time PAM is used, at least one PAM operator would be designated to monitor each system by viewing the data or data products that would be streamed in real-time or near real-time to a computer workstation and monitor, which would be located either on an Ocean Wind vessel or onshore. The PAM operator would work in coordination with the visual PSOs to ensure no detections of marine mammals prior to detonation occurring. The PAM operator would inform the Lead PSO on-duty of any animal detections approaching or within the applicable ranges of interest to the detonation activity via the data collection software (*i.e.,* Mysticetus or a similar system), who would then be responsible for requesting the necessary mitigation procedures. The PAM operator would monitor to and past the clearance zone for large whales (10 km), as possible.

Ocean Wind would also be required to perform aerial surveys, given the size of the UXO/MEC detonation zones, and at least two PSOs must also be located on the plane during aerial surveys that would occur before, during, and after UXO/detonation events. Aerial PSOs (which would be the same as the vessel-based PSOs) would continue to monitoring for marine mammals before, during, and after the detonation has occurred.

PSOs will monitor the clearance zone for the presence of marine mammals for 60 minutes before, throughout the detonation event, and for 30 minutes after. Detonation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 60 minutes immediately prior to detonation occurring. For detonation zones (based on UXO/MEC charge weight) larger than 2 km, a secondary vessel would be used to monitor the detonation zone(s). In the event a secondary vessel is needed, two PSOs would be located at an appropriate vantage point on this vessel and would maintain watch during the same time period as the PSOs on the primary monitoring vessel. Ocean Wind would be required to ensure that the clearance zones are fully (100 percent) monitored prior to, during, and after detonation events.

During all observation periods related to UXO/MEC detonation, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. PSOs located on the UXO/MEC monitoring vessel would also be equipped with ''Big Eye'' binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control). These would be mounted on a pedestal on the deck of the vessel at the most appropriate vantage point that would provide for the optimal sea surface observation, as well as safety of the PSO.

HRG Surveys

Ocean Wind would be required to implement the following procedures during all HRG surveys.

Between four and six PSOs would be present on every 24-hour survey vessel, and two to three PSOs would be present on every 12-hour survey vessel. Ocean Wind would be required to have at least one PSO on active duty during HRG surveys that are conducted during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and at least two during HRG surveys that are conducted during nighttime hours. During all observation periods, PSOs must use standard handheld (7x) binoculars and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* IR/Thermal camera) to monitor clearance and shutdown zones, as necessary. NMFS does not require the use of PAM during HRG survey activities.

All PSOs would begin monitoring 30 minutes prior to the activation of boomers, sparkers, or CHIRPs; throughout boomer, sparker, or CHIRP use; and for 30 minutes after the use of the acoustic sources has ceased.

Given that multiple HRG vessels may be operating concurrently, any observations of marine mammals would be required to be communicated to PSOs on all nearby survey vessels.

Ramp-up of boomers, sparkers, and CHIRPs would only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of survey activities utilizing the specified acoustic sources.

During daylight hours when survey equipment is not operating, Ocean Wind would ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports.

Marine Mammal Passive Acoustic Monitoring

Ocean Wind would be required to utilize a PAM system to supplement visual monitoring for all monopile and pin pile installations, as well as during all UXO/MEC detonations. The PAM system must be monitored by a minimum of one PAM operator beginning at least 60 minutes prior to soft start of impact pile driving of monopiles and pin piles and UXO/MEC detonation, at all times during monopile and pin pile installation and UXO/MEC detonation, and 30 minutes post-completion of impact pile installation and UXO/MEC detonation. PAM PSOs must immediately communicate all detections of marine mammals at any distance (*i.e.,* not limited to the Level B harassment zones) to visual PSOs, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination.

PAM operators may be on watch for a maximum of 4 consecutive hours followed by a break of at least 2 hours between watches. PAM operators must be required to demonstrate that they have completed specialized training for operating PAM systems, including identification of species-specific mysticete vocalizations. PSOs can act as PAM operators or visual PSOs (but not simultaneously) as long as they demonstrate that their training and experience are sufficient to perform each task.

Some PAM systems may be used for real-time mitigation monitoring. This can utilize a variety of sources, but the most likely options, as proposed in Ocean Wind's PSMMP, will be discussed here.

Towed PAM systems may be utilized for the Ocean Wind 1 project. These would consist of cabled hydrophone arrays that would be deployed from a vessel and then typically monitored from a tow vessel. Notably, several challenges exist when using a towed PAM system (*i.e.,* the tow vessel may not be fit for the purpose as it may be towing other equipment, operating sound sources, or working in patterns not conducive to effective PAM). Furthermore, detection and localization capabilities for low-frequency cetacean calls (*i.e.,* mysticete species) can be difficult in a commercial deployment setting. Alternatively, these systems have many positive benefits, as they are often low cost to operate, have high mobility, and are fairly easy and reliable to operate. These types of systems also work well in conjunction with visual monitoring efforts.

Another PAM system being considered by Ocean Wind are mobile and hybrid PAM systems that are often autonomous and may utilize Autonomous Surface Vehicle (ASV) and radio-linked autonomous acoustic recorders.

Ocean Wind plans to deploy PAM arrays specific for mitigation and monitoring of marine mammals outside of the shutdown zone to optimize the PAM system's capabilities to monitor for the presence of animals potentially entering these zones. The exact configuration and number of PAM systems would depend on the size of the zone(s) being monitored, the amount of noise expected in the area, and the characteristics of the signals being monitored. More closely spaced hydrophones would allow for more directionality, and perhaps, range to the vocalizing marine mammals; although, this approach would add additional costs and greater levels of complexity to the project. As larger baleen cetacean species (*i.e.,* mysticetes), which would produce loud and lower-frequency vocalizations, may be able to be heard with fewer hydrophones spaced at greater distances. However, smaller cetaceans (such as mid-frequency delphinids; odontocetes) may necessitate more hydrophones and to be spaced closer together given the shorter range of the shorter, mid-frequency acoustic signals (*e.g.,* whistles and echolocation clicks). As there are no ''perfect fit'' single optimal array configurations, these set-ups would need to be considered on a case-by-case basis.

A Passive Acoustic Monitoring Plan must be submitted to NMFS and BOEM for review and approval at least 180 days prior to the planned start of monopile and pin pile installations. PAM should follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.,* 2021). The plan must describe all proposed PAM equipment, procedures, and protocols. However, NMFS considers PAM usage for every project on a case-by-case basis and would continue discussions with Ocean Wind for choosing the PAM system that is determined to be appropriate for this proposed project.

Acoustic Monitoring for Sound Field and Harassment Isopleth Verification (SFV)

During the installation of the first 3 monopile foundations, the installation of the first full jacket foundation (consisting of 16 total pin piles), and during all UXO/MEC detonations, Ocean Wind must empirically determine source levels, the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds and the transmission loss coefficient(s). Ocean Wind may also estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from in situ measurements conducted at several distances from the monopile and pin piles being driven and all UXOs/MECs being detonated. Ocean Wind must measure received levels at a standard distance of 750 m from the monopiles and pin piles and at both the presumed modeled Level A harassment and Level B harassment threshold ranges, or an alternative distance as agreed to in the SFV Plan.

If acoustic field measurements collected during installation of the first or subsequent monopile, pin pile, and UXOs/MEC being detonated indicate ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds are greater than the ranges predicted by modeling (assuming 10-dB attenuation), Ocean Wind must implement additional noise mitigation measures prior to installing the next monopile or pin pile, or detonating any additional UXOs/MECs. Initial additional measures may include improving the efficacy of the implemented noise mitigation technology (*e.g.,* BBC, DBBC) and/or modifying the piling schedule to reduce the sound source. Each sequential modification would be evaluated empirically by acoustic field measurements. In the event that field measurements indicate ranges to isopleths corresponding to Level A harassment and Level B harassment thresholds are greater than the ranges predicted by modeling (assuming 10 dB attenuation), NMFS may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols. If harassment zones are expanded beyond an additional 1,500 m, additional PSOs would be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m.

If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Ocean Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles and pin piles and for detonation of all UXOs/MECs. For a modification request to be considered by NMFS, Ocean Wind would have had to conduct SFV on 3 or more monopiles and 1 entire jacket foundation (16 pin piles) and on all UXOs/MECs to verify that zone sizes are consistently smaller than predicted by modeling (assuming 10 dB attenuation). In addition, if a subsequent monopile and pin pile installation and location is selected that was not represented by previous three locations (*i.e.,* substrate composition, water depth), SFV would be conducted. Furthermore, if a subsequent UXO/MEC charge weight is encountered and/or detonation location is selected that was not representative of the previous locations (*i.e.,* substrate composition, water depth), SFV would also be required to be conducted. Upon receipt of an interim SFV report, NMFS may adjust zones (*i.e.,* Level A harassment, Level B harassment, clearance, and/or shutdown) to reflect SFV measurements. The shutdown and clearance zones for pile driving would be equivalent to the measured range to the Level A harassment isopleths plus 10 percent (shutdown zone) and 20 percent (clearance zone), rounded up to the nearest 100 m for PSO clarity. However, the minimum visibility zone would not be decreased to a radius smaller than 1.65 km in the summer (and 2.5 km in the winter) from the pile. The shutdown zone for sei, fin, blue, and sperm whales (*i.e.,* large whales) would not be reduced to a size less than 1.8 km in the summer and 2.5 km in the winter. The visual and PAM clearance and shutdown zones for North Atlantic right whales would not be decreased, regardless of acoustic field measurements. The Level B harassment zone would be equal to the largest measured range to the Level B harassment isopleth.

Ocean Wind would be required to submit a SFV Plan at least 180 days prior to the planned start of impact pile driving or any detonation activities. The plan would describe how Ocean Wind would ensure that the first three monopile and pin pile installation sites and each UXO/MEC detonation site selected for SFV are representative of the rest of the monopile and pin pile installation and UXO/MEC sites. In the case that these sites are not determined to be representative of all other monopile and pin pile installation sites and UXO/MEC detonation locations, Ocean Wind would include information on how additional sites would be selected for SFV. The plan would also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan would describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Ocean Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first 3 piles and pin pile installation for the first full jacket foundation (16 pin piles).

Reporting

Prior to any construction activities occurring, Ocean Wind would provide a report to NMFS (at *itp.potlock@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that demonstrates that all required training for Ocean Wind personnel, which includes the vessel crews, vessel captains, PSOs, and PAM operators have completed all required trainings.

NMFS would require standardized and frequent reporting from Ocean Wind during the life of the proposed regulations and LOA. All data collected relating to the Ocean Wind 1 project would be recorded using industry-standard software (*e.g.,* Mysticetus or a similar software) installed on field laptops and/or tablets. Ocean Wind would be required to submit weekly, monthly and annual reports as described below. During activities requiring PSOs, the following information would be collected and reported related to the activity being conducted:

- Date and time that monitored activity begins or ends;
- Construction activities occurring during each observation period;
- Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
- PSO who sighted the animal;
- Time of sighting;
- Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility);
- Water conditions (*e.g.,* sea state, tide state, water depth);
- All marine mammal sightings, regardless of distance from the construction activity;
- Species (or lowest possible taxonomic level possible);
- Pace of the animal(s);
- Estimated number of animals (minimum/maximum/high/low/best);

- Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*);
- Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
- Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity;
- Animal's closest distance and bearing from the pile being driven, UXO/MEC, or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zones;
- Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, UXO/MEC detonation, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft start for pile driving, active pile driving, post-UXO/MEC detonation, *etc.*);
- Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action;
- Other human activity in the area.

For all real-time acoustic detections of marine mammals, the following must be recorded and included in weekly, monthly, annual, and final reports:

a. Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name;

b. Bottom depth and depth of recording unit (in meters);

c. Recorder (model & manufacturer) and platform type (*i.e.,* bottom-mounted, electric glider, *etc.*), and instrument ID of the hydrophone and recording platform (if applicable);

d. Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. *i.e.* EST time zone is UTC–5);

e. Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ);

f. Deployment/retrieval dates and times (in ISO 8601 format);

g. Recording schedule (must be continuous);

h. Hydrophone and recorder sensitivity (in dB *re. 1* μ*Pa*);

i. Calibration curve for each recorder;

j. Bandwidth/sampling rate (in Hz);

k. Sample bit-rate of recordings; and,

l. Detection range of equipment for relevant frequency bands (in meters).

For each detection the following information must be noted:

a. Species identification (if possible);

b. Call type and number of calls (if known);

c. Temporal aspects of vocalization (date, time, duration, *etc.,* date times in ISO 8601 format);

d. Confidence of detection (detected, or possibly detected);

e. Comparison with any concurrent visual sightings;

f. Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities;

g. Location of recorder and construction activities at time of call;

h. Name and version of detection or sound analysis software used, with protocol reference;

i. Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and,

j. Name of PAM operator(s) on duty.

If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any impact or vibratory pile-driving vessel, dedicated PSO vessel, construction survey vessel, or during vessel transit, Ocean Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755–6622, to the U.S. Coast Guard via channel 16, and through the WhaleAlert app (*http://www.whalealert/org/*) as soon as feasible but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed.

If a North Atlantic right whale is detected via Ocean Wind PAM, the date, time, location (*i.e.,* latitude and longitude of recorder) of the detection as well as the recording platform that had the detection must be reported to *nmfs.pacmdata@noaa.gov* as soon as feasible, but no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*).

Prior to initiation of project activities, Ocean Wind must demonstrate in a report submitted to NMFS (at *itp.potlock@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that all required training for Ocean Wind personnel (including vessel crew and captains, and PSOs) has been completed.

Weekly Report—Ocean Wind would be required to compile and submit weekly PSO and PAM reports to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that document the daily start and stop of all pile driving, HRG survey, or UXO/MEC detonation activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals, any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise attenuation system(s) used and its performance. Weekly reports would be due on Wednesday for the previous week (Sunday–Saturday).

Monthly Report—Ocean Wind would be required to compile and submit monthly reports that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, and all observations of marine mammals. Monthly reports would be due on the 15th of the month for the previous month. The report should note the location and date of any turbines that become operational.

Annual Report—Ocean Wind would be required to submit an annual summary report to NMFS no later than 90 days following the end of a given calendar year describing, in detail, the following:

- Total number of marine mammals of each species/stock detected and how many were within designated Level A harassment and Level B harassment zones with comparison to authorized take of marine mammals for the associated activity type;
- Marine mammal detections and behavioral observations before, during, and after each activity;
- What mitigation measures were implemented (*i.e.,* number of shutdowns or clearance zone delays, *etc.*) or, if no mitigative action was taken, why not;
- Operational details (*i.e.,* days of impact and vibratory pile driving, days/amount of HRG survey effort, total number and charge weights related to UXO/MEC detonations, *etc.*);
- SFV/SSV results;
- PAM systems used;
- The results, effectiveness, and which noise abatement systems were used during relevant activities (*i.e.,* impact pile driving, UXO/MEC detonation);

- Summarized information related to Situational Reporting; and,
- Any other important information relevant to the Ocean Wind 1 project, including additional information that may be identified through the adaptive management process.

A final annual report would be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final.

Five-year Report—By 90 days after the expiration of the rule, Ocean Wind would submit a final report that summarizes all of the data contained within the annual reports. A final five-year report would be prepared and submitted within 60 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final.

Situational Reporting

Specific situations encountered during the development of Ocean Wind 1 would require immediate reporting to be undertaken. These situations and the relevant procedures include:

- If a marine mammal observation occurs during vessel transit, the following information must be recorded:

a. Time, date, and location;

b. The vessel's activity, heading, and speed;

c. Sea state, water depth, and visibility;

d. Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal);

e. Initial distance and bearing to marine mammal from vessel and closest point of approach; and,

f. Any avoidance measures taken in response to the marine mammal sighting.

- If a sighting of a stranded, entangled, injured, or dead marine mammal occurs. In this situation, the sighting would be reported to OPR, the NMFS RWSAS hotline, and the NMFS Greater Atlantic Regional Fisheries Office (GARFO) Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866–755–6622), and the U.S. Coast Guard within 24 hours. The report must include the following information:

a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

b. Species identification (if known) or description of the animal(s) involved;

Condition of the animal(s) (including carcass condition if the animal is dead);

c. Observed behaviors of the animal(s), if alive;

d. If available, photographs or video footage of the animal(s); and

e. General circumstances under which the animal was discovered.

- If a marine mammal is injured or killed as a result of Ocean Wind 1 project-related activities or vessels. In this case, the vessel captain or PSO on board shall immediately report the strike incident to the NMFS Office of Protected Resources and the GARFO within and no later than 24 hours. If activities related to the Ocean Wind 1 project caused the injury or death of the animal, Ocean Wind would supply a vessel to assist with any salvage efforts, if requested by NMFS. The notification of the strike would include:

a. Time, date, and location (latitude/longitude) of the incident;

b. Species identification (if known) or description of the animal(s) involved;

c. Vessel's speed during and leading up to the incident;

d. Vessel's course/heading and what operations were being conducted (if applicable);

e. Status of all sound sources in use;

f. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

g. Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

h. Estimated size and length of animal that was struck;

i. Description of the behavior of the marine mammal immediately preceding and following the strike;

j. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

k. Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and

l. To the extent practicable, photographs or video footage of the animal(s).

Sound Monitoring Reporting

Ocean Wind will be required to provide the initial results of SFV (including measurements) to NMFS in interim reports after each monopile installation and pin pile installation or the first three piles as soon as they are available, but no later than 48 hours after each installation. Ocean Wind would also have to provide interim reports after every UXO/MEC detonation as soon as they are available, but no later than 48 hours after each detonation. If SFV is required for subsequent monopile and pin pile installations, the same reporting timeline and data requirements apply. In addition to in situ measured ranges to the Level A harassment and Level B harassment isopleths, the acoustic monitoring report must include: SPL_{peak}, SPL_{rms} that contains 90 percent of the acoustic energy, single strike sound exposure level, integration time for SPL_{rms}, SEL_{ss}, and 24-hour cumulative SEL extrapolated from measurements. All these levels must be reported in the form of median, mean, max, and minimum. The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported. The acoustic monitoring report must also include a description of the hydrophones used, hydrophone and water depth, distance to the pile driven, and sediment type at the recording location. Final results of SFV must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of monopiles and pin piles and detonations of up to 10 UXOs/MECs.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' by mortality, serious injury, and Level A or Level B harassment, we consider other factors, such as the likely nature of any behavioral responses (*e.g.,* intensity, duration), the context of any such responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the

1989 preamble for NMFS' implementing regulations (54 FR 40338, September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

In the Estimated Take section, we identified the subset of potential effects that would be expected to rise to the level of take, and then identified the number of takes by Level A harassment and Level B harassment that we estimate are reasonably expected to occur based on the methods described. The impact that any given take would have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of a disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, *etc.*). In this rule, we evaluate the likely impacts of the enumerated harassment takes that are proposed for authorization in the context of the specific circumstances surrounding these predicted takes. We also collectively evaluate this information, as well as other more taxa-specific information and mitigation measure effectiveness, in group-specific discussions that support our negligible impact conclusions for each stock. As also described above, no serious injury or mortality is expected or proposed for authorization for any species or stock.

The Description of the Specified Activities section describes the specified activities proposed by Ocean Wind that may result in take of marine mammals and an estimated schedule for conducting those activities. Ocean Wind has provided a realistic construction schedule (*e.g.,* Ocean Wind's schedule reflects the maximum number of piles they anticipate to be able to drive each month pile driving is authorized to occur); however, we recognize schedules may shift for a variety of reasons (*e.g.,* weather or supply delays). However, the total amount of take would not exceed the maximum annual total in any given year and 5-year totals indicated in Tables 36 and 35, respectively.

We base our analysis and negligible impact determination (NID) on the maximum number of takes that would be reasonably expected to occur and are proposed to be authorized in the LOA, if issued, although, as stated before, the number of takes are only a part of the analysis, which includes extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals. To avoid repetition, we provide some general analysis in this Negligible Impact Analysis and Determination section that applies to all the species listed in Table 3, given that some of the anticipated effects of Ocean Wind's construction and operation activities on marine mammals are expected to be relatively similar in nature. Then, we subdivide into more detailed discussions for mysticetes, odontocetes, and pinnipeds which have broad life history traits that support an overarching discussion of some factors considered within the analysis for those groups (*e.g.,* habitat-use patterns, high-level differences in feeding strategies).

Last, we provide a negligible impact determinations for each species, providing species or stock-specific information or analysis, where appropriate, for example, for North Atlantic right whales given their population status. Organizing our analysis by grouping species or stocks that share common traits or that would respond similarly to effects of Ocean Wind's proposed activities and then providing species- or stock-specific information allows us to avoid duplication while assuring that we have analyzed the effects of the specified activities on each affected species or stock. It is important to note that in the group or species sections, we base our negligible impact analysis on the maximum annual take that is predicted under the 5-year rule—however, the majority of the impacts are associated with turbine and substations construction, which will occur largely within a 2-year period. The estimated take in the other years is expected to be notably less, which is reflected in the total take that would be allowable under the rule (see Tables 34, 35, and 36).

Behavioral Disturbance

The amount of harassment Ocean Wind has requested, and NMFS is proposing to authorize, is based on exposure models that consider the outputs of an acoustic source and propagation model. Several conservative parameters and assumptions are ingrained into these models such as assuming forcing functions that consider direct contact with piles (*i.e.,* no cushion allowances) and applying the highest monthly sound speed profile to all months within a given season, and the exposure model results do not reflect any mitigation measures (except for North Atlantic right whales) or avoidance response, and some of those results have been adjusted upward to consider sighting or group size data, where necessary. The resulting values for each stock were then used by Ocean Wind to request take. The only case in which mitigation measures (other than source level reduction via a noise abatement system) was considered is the potential for PTS (Level A harassment) of North Atlantic right whales (the model predicted a maximum of 1.08 PTS exposures but Ocean Wind did not request and we are not proposed to authorize Level A harassment of this species due, in large part, to the extended mitigation measures for this species). Therefore, for all species, the amount of take proposed to be authorized represents the maximum amount of Level A harassment and Level B harassment that is reasonably expected to occur.

In general, NMFS anticipates that impacts on an individual that has been harassed are likely to be more intense when exposed to higher received levels and for longer a duration (though this is in no way a strictly linear relationship for behavioral effects throughout species, individuals, or circumstances) and less severe impacts result when exposed to lower received levels and for brief duration. However, there is also growing evidence of the importance of contextual factors such as distance from a source in predicting marine mammal behavioral response to sound—*i.e.,* sounds of a similar level emanating from a more distant source have been shown to be less likely to evoke a response of equal magnitude (*e.g.,* DeRuiter, 2012; Falcone *et al.,* 2017). As described in the Potential Effects to Marine Mammals and their Habitat section, the intensity and duration of any impact resulting from exposure to Ocean Wind's activities is dependent upon a number of contextual factors including, but not limited to, sound source frequencies, whether the sound source is moving towards the animal, hearing ranges of marine mammals, behavioral state at time of exposure, status of individual exposed (*e.g.,* reproductive status, age class, health) and an individual's experience with similar sound sources. Ellison *et al.* (2012) and Moore and Barlow (2013), among others, emphasize the importance of context (*e.g.,* behavioral state of the animals, distance from the sound source.) in evaluating behavioral responses of marine mammals to acoustic sources. Harassment to marine mammals may result in behavioral modifications of marine mammals (*e.g.,* avoidance, temporary cessation of foraging or communicating, changes in respiration or group dynamics, masking) or may result in auditory impacts such as hearing loss. In addition, some of the lower level physiological stress responses (*e.g.,* orientation or startle response, change in respiration, change in heart rate) discussed previously would likely co-occur with the behavioral modifications, although these physiological responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. Takes by Level B harassment, then, may have a stress-related physiological component as well; however, we would not expect Ocean Wind's activities to present conditions of long-term and continuous exposure to noise leading to long-term physiological stress responses in marine mammals that could affect reproduction or survival.

In the range of potential behavioral effects that might expect to be part of a response that qualifies as an instance of Level B harassment by behavioral disturbance (which by nature of the way it is modeled/counted, occurs within one day), the less severe end might include exposure to comparatively lower levels of a sound, at a detectably greater distance from the animal, for a few or several minutes. A less severe exposure of this nature could result in a behavioral response, such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time or breaking off one or a few feeding bouts. More severe effects could occur if an animal gets close enough to the source to receive a comparatively higher level, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day. However, such severe behavioral effects are expected to occur infrequently.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure, when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat, are more likely to be significant if they last more than one day or recur on subsequent days (Southall *et al.,* 2007) due to diel and lunar patterns in diving and foraging behaviors observed in many cetaceans (Baird *et al.,* 2008, Barlow *et al.,* 2020, Henderson *et al.,* 2016, Schorr *et al.,* 2014). It is important to note the water depth in the Ocean Wind 1 project area is shallow (15 to 36 m) and deep diving species, such as beaked whales and sperm whales, are not expected to be engaging in deep foraging dives when exposed to noise above NMFS harassment thresholds during the specified activities. Therefore, we do not anticipate impacts to deep foraging behavior to be impacted by the specified activities.

It is also important to identify that the estimated number of takes does not necessarily equate to the number of individual animals Ocean Wind expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level A harassment and Level B harassment threshold) that are anticipated to occur over the 5-year period. These instances may represent either brief exposures (*e.g.,* seconds UXO/MEC detonation or seconds to minutes for HRG surveys) or, in some cases, longer durations of exposure within a day. Some individuals of a species may experience recurring instances of take over multiple days over the course of the year, while some members of a species or stock may experience one exposure as they move through an area or not experience take at all which means that the number of individuals taken is smaller than the total estimated takes. In short, for species that are more likely to be migrating through the area and/or for which only a comparatively smaller number of takes are predicted (*e.g.,* some of the mysticetes), it is more likely that each take represents a different individual, whereas for non-migrating species with larger amounts of predicted take, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some would be exposed multiple times.

Impact pile driving is most likely to result in a higher magnitude and severity of behavioral disturbance than other activities *(i.e.,* vibratory pile driving, UXO/MEC detonation and HRG surveys). Impact pile driving has higher source levels than vibratory pile driving and HRG sources. HRG surveys also produce much higher frequencies than pile driving resulting in minimal sound propagation. While UXO/MEC detonations may have higher source levels, impact pile driving is planned for longer durations (*i.e.,* a maximum of 10 UXO/MEC detonations are planned, which result in only instantaneous exposures). While impact pile driving is anticipated to be most impactful for these reasons, impacts are minimized through implementation of mitigation measures, including soft-start, use of a sound attenuation system, and the implementation of clearance zones that would facilitate a delay of pile driving if marine mammals were observed approaching or within areas that could be ensonified above sound levels that could result in Level B harassment. Given sufficient notice through the use of soft-start, marine mammals are expected to move away from a sound source that is annoying prior to becoming exposed to very loud noise levels. The requirement that pile driving can only commence when the full extent of all clearance zones are fully visible to visual PSOs would ensure a higher marine mammal detection capability, enabling a high rate of success in implementation of clearance zones. Furthermore, Ocean Wind would be required to utilize PAM during all clearance periods, during impact pile driving, and after pile driving has ended during the post-piling period. PAM has shown strength when used in conjunction with visual observations and increases the detection capabilities of marine mammals (Van Parijs *et al.,* 2021). These measures also apply to UXO/MEC detonation(s) which also have the potential to elicit more severe behavioral reactions in the unlikely event that an animal is relatively close to the explosion in the instance that it occurs; hence, severity of behavioral responses are expected to be lower than without mitigation.

Occasional, milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more severe response, if they are not expected to be repeated over sequential days, impacts to individual fitness are not anticipated. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer *et al.,* 2018; Harris *et al.,* 2017; King *et al.,* 2015; NAS 2017; New *et al.,* 2014; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015).

Temporary Threshold Shift (TTS)

TTS is one form of Level B harassment that marine mammals may incur through exposure to Ocean Wind's activities and, as described earlier, the proposed takes by Level B harassment may represent takes in the form of behavioral disturbance, TTS, or both. As discussed in the Potential Effects to Marine Mammals and their Habitat section, in general, TTS can last from a few minutes to days, be of varying degree, and occur across different frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. Impact and vibratory pile driving generate sounds in the lower frequency ranges (with most of the energy below 1–2 kHz but with a small amount energy ranging up to 20 kHz); therefore, in general and all else being equal, we would anticipate the potential for TTS is higher in low frequency cetaceans (*i.e.,* mysticetes) than other marine mammal hearing groups and would be more likely to occur in frequency bands in which they communicate. However, we would not expect the TTS to span the entire communication or hearing range of any species given the frequencies produced by pile driving do not span entire hearing ranges for any particular species. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Ocean Wind's pile driving and UXO/MEC detonation activities would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. However, the mitigation measures proposed by Ocean Wind and proposed by NMFS, further reduce the potential for TTS in mysticetes.

Generally, both the degree of TTS and the duration of TTS would be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The thresholds for the onset of TTS was discussed previously in this rule (refer back to Table 6). However, source level alone is not a predictor of TTS. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the proposed mitigation and the nominal speed of receiver relative to the stationary sources such as impact pile driving. The recovery time of TTS is also of importance when considering the potential impacts from TTS. In TTS laboratory studies (as discussed in the Potential Effects to Marine Mammals and their Habitat section), some using exposures of almost an hour in duration or up to 217 SEL, almost all individuals recovered within 1 day (or less, often in minutes) and we note that while the pile driving activities last for hours a day, it is unlikely that most marine mammals would stay in the close vicinity of the source long enough to incur more severe TTS. UXO/MEC detonation also has the potential to result in TTS; however, given the duration of exposure is extremely short (milliseconds), the degree of TTS (*i.e.,* the amount of dB shift) is expected to be small and TTS duration is expected to be short (minutes to hours). Overall, given the small number of times that any individual might incur TTS, the low degree of TTS and the short anticipated duration, and the unlikely scenario that any TTS overlapped the entirety of a critical hearing range, it is unlikely that TTS of the nature expected to result from Ocean Wind's activities would result in behavioral changes or other impacts that would impact any individual's (of any hearing sensitivity) reproduction or survival.

Permanent Threshold Shift

Ocean Wind has requested, and NMFS proposed to authorize, a very small amount of take by PTS to some marine mammal individuals. The numbers of proposed takes by Level A harassment are relatively low for all marine mammal stocks and species: sei whales (1 take), fin whales (4 takes), minke whales (22 takes), humpback whales (6 takes), the coastal stock of bottlenose dolphins (11 takes), harbor porpoises (79 takes), gray seals (35 takes), and harbor seals (48 takes). The only activities from which we anticipate PTS may occur is from exposure to impact pile driving and UXO/MEC detonations, which produce sounds that are both impulsive and primarily concentrated in the lower frequency ranges (below 1 kHz) (David, 2006; Krumpel *et al.,* 2021).

There are no PTS data on cetaceans and only one instance of PTS being induced in an older harbor seals (Reichmuth *et al.,* 2019); however, available data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds (Southall *et al.,* 2007; NMFS 2018; Southall *et al.,* 2019) suggest that most threshold shifts occur in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). We would anticipate a similar result for PTS. Further, no more than a small degree of PTS is expected to be associated with any of the Level A harassment take incurred, given it is unlikely that animals would stay in the close vicinity of a source for a duration long enough to produce more than a small degree of PTS.

PTS would consist of minor degradation of hearing capabilities occurring predominantly at frequencies one-half to one octave above the frequency of the energy produced by pile driving or instantaneous UXO/MEC detonation (*i.e.,* the low-frequency region below 2 kHz) (Cody and Johnstone, 1981; McFadden, 1986; Finneran, 2015), not severe hearing impairment. If hearing impairment occurs from either impact pile driving or UXO/MEC detonation, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics. However, given sufficient notice through use of soft-start prior to the full hammer energy that would be used during impact pile driving, marine mammals are expected to move away from a sound source that is annoying prior to it becoming potentially injurious or resulting in more severe behavioral reactions. Furthermore, while up to 10 UXOs/MECs have been estimated to be detonated, the exposure analysis assumed the worst-case scenario of assuming that all of the UXOs/MECs found would consist of the largest charge weight of UXO/MEC (E12; 454 kg). It is highly unlikely that all charges would be this size, which would reduce the take estimate. Furthermore, Ocean Wind plans to implement sound attenuation during all UXO/MEC detonations that would further be expected to reduce take of marine mammals.

Auditory Masking or Communication Impairment

The ultimate potential impacts of masking on an individual are similar to those discussed for TTS (*e.g.,* decreased ability to communicate, forage effectively, or detect predators), but an important difference is that masking only occurs during the time of the signal, versus TTS, which continues beyond the duration of the signal. Also, though, masking can result from the sum of exposure to multiple signals, none of which might individually cause TTS. Fundamentally, masking is referred to as a chronic effect because one of the key potential harmful components of masking is its duration—the fact that an animal would have reduced ability to hear or interpret critical cues becomes much more likely to cause a problem the longer it is occurring. Also inherent in the concept of masking is the fact that the potential for the effect is only present during the times that the animal and the source are in close enough proximity for the effect to occur (and further, this time period would need to coincide with a time that the animal was utilizing sounds at the masked frequency). As our analysis has indicated, we expect that impact pile driving foundations have the greatest potential to mask marine mammal signals and this pile driving may occur for several, albeit intermittent, hours per day. Masking is fundamentally more of a concern at lower frequencies (which are pile driving dominant frequencies), because low frequency signals propagate significantly further than higher frequencies and because they are more likely to overlap both the narrower low frequency calls of mysticetes, as well as many non-communication cues such as fish and invertebrate prey, and geologic sounds that inform navigation. However, the area in which masking would occur for all marine mammal species and stocks (*e.g.,* predominantly in the vicinity of the foundation pile being driven) is small relative to the extent of habitat used by each species and stock. In addition, the waters off of New Jersey are not known to have any particular foraging or reproductive significance for any marine mammals. In summary, the nature of Ocean Wind's activities paired with habitat use by marine mammals do not support the likelihood that the level of masking occurring would have the potential to affect reproductive success or survival.

Impacts on Habitat and Prey

Construction activities may result in fish and invertebrate mortality or injury very close to pile driving, HRG surveys, or UXO/MEC detonation and may cause some fish to leave the area of disturbance. It is anticipated any mortality or injury would be limited to a very small subset of available prey and the implementation of mitigation measures such as the use of bubble curtains during pile driving and UXO/MEC detonation would further limit the degree of impact (and noting UXO/MEC detonation would be limited to 10 events over 5 years). Behavioral changes in prey in response to construction activities could temporarily impacting marine mammals' foraging opportunities in a limited portion of the foraging range; but, because of the relatively small area of the habitat that may be affected at any given time (*e.g.,* around a pile being driven) and that there are no known areas of foraging importance to marine mammals in the action area, the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences.

Cable presence and operation are not anticipated to impact marine mammal habitat as these would be buried and any electromagnetic fields emanating from the cables are not anticipated to result in consequences that would impact marine mammals prey to the extent they would be unavailable for consumption and marine mammal habitat does not occur within the substrate where cables would be present.

The presence and operation of turbines within the lease area could have longer-term impacts on marine mammal habitat as the project would result in the presence of the structures in the Atlantic Ocean where marine mammals occur for 30+ years. The presence and operation of structures such as wind turbines are, in general, likely to result in local and broader oceanographic effects in the marine environment, and may disrupt marine mammal prey such as dense aggregations and distribution of zooplankton through altering the strength of tidal currents and associated fronts, changes in stratification, primary production, the degree of mixing, and stratification in the water column (Chen *et al.,* 2021, Johnson *et al.,* 2021; Christiansen *et al.,* 2022; Dorrell *et al.,* 2022). However, the scale of impacts is difficult to predict and may vary from hundreds of meters for local individual turbine impacts (Schultze *et al.,* 2020) to large-scale dipoles of surface elevation changes stretching hundreds of kilometers (Christiansen *et al.,* 2022). In 2022, NMFS hosted a workshop to better understand the current scientific knowledge and data gaps around the potential long-term impacts of offshore wind farm operations in the Atlantic Ocean. The report from that workshop is pending and NMFS will consider its findings in development of the final rule for this action. As discussed in the Potential Effects to Marine Mammals and Their Habitat section, Ocean Wind 1 is in an area of the MAB that experiences coastal upwelling and is on the inshore edge of the Cold Pool footprint. While there is some chance of local oceanographic impacts from wind farm presence and operation, meaningful ocean impacts relative to stratification and the Cold Pool that would affect marine mammal habitat and prey are unlikely. This rule considers the presence of the turbines scheduled to be fully constructed through the course of the rule and the likelihood that some subset of the turbines (approximately 68) will likely become operational in 2024 with the last 30 being installed and operational between 2024 and 2025. Further, this area does not support dense congregations of zooplankton (baleen whale prey) that could be impacted if long-term oceanographic changes occurred. For these reasons, we predict only small habitat changes from wind farm operation and if oceanographic features are affected by wind farm operation, the impact on marine mammal habitat and their prey is likely to be insignificant.

Mitigation To Reduce Impacts on All Species

This proposed rulemaking includes a variety of mitigation measures designed to minimize impacts on all marine mammals, with a focus on North Atlantic right whales (latter described in more detail below). For impact pile driving of foundation piles, eight overarching mitigation measures are proposed, which are intended to reduce both the number and intensity of marine mammal takes: (1) time of year/seasonal restrictions; (2) use of multiple PSOs to visually observe for marine mammals (with any detection within designated zones triggering delay or shutdown); (3) use of PAM to acoustically detect marine mammals, with a focus on detecting baleen whales (with any detection within designated zones triggering delay or shutdown); (4) implementation of clearance zones; (5) implementation of shutdown zones; (6) use of soft-start; (7) use of noise abatement technology; and, (8) maintaining situational awareness of marine mammal presence through the requirement that any marine mammal sighting(s) by Ocean Wind project personnel must be reported to PSOs.

When monopile or jacket foundation installation does occur, Ocean Wind is committed to reducing the noise levels generated by impact pile driving to the lowest levels practicable and ensuring that they do not exceed a noise footprint above that which was modeled, assuming a 10 dB attenuation. Use of a soft-start will allow animals to move away from (*i.e.,* avoid) the sound source prior to the elevation of the hammer energy to the level maximally needed to install the pile (Ocean Wind will not use a hammer energy greater than necessary to install piles). Clearance zone and shutdown zone implementation, required when marine mammals are within given distances associated with certain impact thresholds, will reduce the magnitude and severity of marine mammal take.

To reduce the daily amount of time the area may be ensonified (and thereby decrease daily exposure risk), Ocean Wind will drive no more than two monopiles per day. Ocean Wind indicates the need for up to nine hours of impact pile driving installation activities per each monopile; however, this entire period is unlikely to consist of active hammering as some time would be needed to move vessels and equipment to set up additional monopiles (assuming a full monopile foundation build-out). Specifically, the application notes that ''installation of a single pile at a minimum would involve a 1-hour pre-clearance period, 4 hours of piling, and 4 hours to move to the next piling location where the process would begin again.'' Based on this, at a rate of two monopiles with only 4 hours of active impact hammering being necessary, the physical installation time occurring daily would only consist of 8 hours instead of 18 hours, as that full period would also consist of other activities that are not likely to harass marine mammals (*e.g.,* vessel transit, equipment set-up, pre-clearance monitoring by visual PSOs and PAM operators) outside of active impact driving.

NMFS is also proposing to require Ocean Wind to apply a noise attenuation device (likely a big bubble curtain and another technology, such as a hydro-damper) to ensure sound generated from the project does not exceed that modeled (assuming 10 dB reduction) at given ranges to harassment isopleths, and to minimize noise levels to the lowest level practicable. As an example used previously in the CVOW pilot project, double big bubble curtains are successfully and widely applied across European wind development efforts, and are known to reduce noise levels more than a single big bubble curtain alone (*e.g.*, see Bellman *et al.,* 2020). Further, NMFS will be reviewing the operational reports provided by Ocean Wind to ensure that deployments are successful (*e.g.,* the maximum air flow rate is being used during pile driving).

Mysticetes (North Atlantic Right Whale, Blue Whale, Fin Whale, Sei Whale, Minke Whale, and Humpback Whale)

Six mysticete species of cetaceans (comprising six stocks) are proposed to be taken by harassment. These stocks all use the waters off of New Jersey as a migratory corridor (recognizing that not all animals within a given stock migrate every year), and while some behavior such as foraging may occur sporadically, none of the six species are known to specifically congregate in or around the project area for feeding or reproductive behaviors.

Behavioral data on mysticete reactions to pile driving noise is scant. Kraus *et al.* (2019) predicted that the three main impacts of offshore wind farms on marine mammals would consist of displacement, behavioral disruptions, and stress. Broadly, we can look to studies that have focused on other noise sources such as seismic surveys and military training exercises, which suggest that exposure to loud signals can result in avoidance of the sound source (or displacement if the activity continues for a longer duration in a place where individuals would otherwise have been staying in, which is less likely for mysticetes in this area), disruption of foraging activities (if they are occurring in the area, which is less likely for mysticetes in the project area), local masking around the source, associated stress responses, and impacts to prey, as well as TTS or PTS in some cases.

Mysticetes encountered in the Ocean Wind project area would primarily be migrating through the area, and there are no known areas where any mysticete species concentrate for feeding or reproductive behaviors in or in the vicinity of the project area. If foraging events did occur, these would likely be sporadic and not focused specifically in the area. In any case, it is unlikely dedicated foraging activities in this area would occur, much less consistently during the same hours where impact pile driving is planned to occur. While we have acknowledged above that mortality, hearing impairment, or displacement of mysticete prey species may result locally from impact pile driving or UXO/MEC detonation, given the broad availability of prey species in the area and the low likelihood of mysticete foraging in the area, any impacts from pile driving on mysticete foraging would be expected to be minor. Further, given the fact that mysticete species are expected to predominantly be migrating through, and the relatively low Level B harassment take numbers indicated in Table 35 (between 4 and 118 for the 6 species), it is likely that most of the proposed takes represent an exposure of a different individual, which means that the behavioral impacts to mysticetes are limited to behavioral disturbance occurring on one or two days within a year—an amount that would not be expected to impact reproduction or survival.

Neither North Atlantic right whales nor blue whales are expected or authorized to incur PTS, and the other mysticetes have 1, 4, 6, and 22 Level A harassment takes for sei, fin, humpback, and minke whales, respectively. As described previously, PTS for mysticetes from impact pile driving may overlap frequencies used for communication, navigation, or detecting prey, however, given the nature and duration of the activity, the mitigation measures, and likely avoidance behavior, any PTS is expected to be of a small degree, would be limited to frequencies where pile driving noise is concentrated (*i.e.,* only a small subset of their hearing range) and would not be expected to impact reproductive success or survival.

North Atlantic Right Whales

North Atlantic right whales are listed as endangered under the ESA and, as described in the Effects to Marine Mammals and Their Habitat section, are threatened by a low population abundance, higher than average mortality rates, and lower than average reproductive rates. Recent studies have reported individuals showing poor health or high stress levels (Corkeron *et al.,* 2017) which has further implications on reproductive success (Christiansen *et al.,* 2020; Stewart *et al.,* 2021; Stewart *et al.,* 2022). Given this, the status of the North Atlantic right whale population is of heightened concern and, therefore, merits additional analysis and consideration. NMFS proposes to authorize a maximum of seven takes of North Atlantic right whales, by Level B harassment only, within any given year with no more than 14 takes incidental to all construction activities are proposed to be authorized over the 5-year effectiveness of this proposed rule.

Given their migratory behavior in the project area, we anticipate individual whales would be swimming through the area and it is likely that the number of annual exposures represents individual whales as we do not anticipate whales to linger in the area. Therefore, we anticipate these takes to occur to seven individuals in a given year (*i.e.,* seven individuals incurring a behavioral disturbance on one day within a year). Across all years, while it is possible an animal migrating through could have been exposed during a previous year, the low amount of take proposed to be authorized during the 5-year period of the proposed rule makes this scenario also unlikely. However, if an individual were to be exposed during a subsequent year, the impact of that exposure is likely independent of the previous exposure given the duration between exposures. No mortality, serious injury, or Level A harassment of North Atlantic right whales is anticipated or proposed to be authorized.

North Atlantic right whales are presently experiencing an ongoing UME (beginning in June 2017). Preliminary findings support human interactions, specifically vessel strikes and entanglements, as the cause of death for the majority of North Atlantic right whales. Given the current status of the North Atlantic right whale, the loss of even one individual could significantly impact the population. No mortality, serious injury, or injury of North

Atlantic right whales as a result of the project is expected or proposed to be authorized. Any disturbance to North Atlantic right whales due to Ocean Wind's activities is expected to result in temporary avoidance of the immediate area of construction. As no injury, serious injury, or mortality is expected or authorized, and Level B harassment of North Atlantic right whales will be reduced to the level of least practicable adverse impact through use of mitigation measures, the authorized number of takes of North Atlantic right whales would not exacerbate or compound the effects of the ongoing UME in any way.

As described in the general Mysticete section above, impact pile driving (assuming WTG monopile and OSS pin pile build-out) has the potential to result in the highest amount of annual take (5 Level B harassment takes) and is of greatest concern given loud source levels. The potential types, severity, and magnitude of impacts is also anticipated to mirror that described in the general mysticete section above, including avoidance (the most likely outcome), changes in foraging or vocalization behavior, masking, a small amount of TTS, and temporary physiological impacts (*e.g.,* change in respiration, change in heart rate). Importantly, the effects of the activities proposed by Ocean Wind are sufficiently low-level and localized to specific areas as to not meaningfully impact important behaviors such as migratory behavior of North Atlantic right whales—their primary behavior within the project area. As described above, only seven instances of take are proposed for authorization, with each occurring within a day, and likely any take would only occur once a year to seven different individual animals. If this small number of exposures results in temporary behavioral reactions, such as slight displacement (but not abandonment) of a migratory pathway, it is unlikely to result in energetic consequences that could affect reproduction or survival of any individuals. Overall, NMFS expects that any harassment of North Atlantic right whales incidental to the specified activities would not result in changes to their migration patterns as only temporary avoidance of an area during construction is expected to occur, animals would be migrating through these areas and are not known to remain in this habitat for extensive durations, and that any temporarily displaced animals would be able to return to or continue to travel through these areas once activities have ceased. Although acoustic masking may occur, based on the acoustic characteristics of noise associated with pile driving (*e.g.,* frequency spectra, short duration of exposure given anticipated behavioral patterns (*i.e.,* migration)) and construction surveys (*e.g.,* intermittent signals), NMFS expects masking effects to be minimal (*e.g.,* impact or vibratory pile driving) to none (*e.g.,* construction surveys), and only present in a period of time that a North Atlantic right whale were in the close vicinity of pile driving, which is expected to be infrequent and brief, given time of year restrictions, anticipated mitigation effectiveness, and likely avoidance behaviors. TTS is another potential form of Level B harassment that could result in brief periods of slightly reduced hearing sensitivity, affecting behavioral patterns by making it more difficult to hear or interpret acoustic cues within the frequency range (and slightly above) of sound produced during impact pile driving; however, given the North Atlantic right whale-specific mitigation (described below), it is unlikely TTS would occur and, if it did, any TTS would likely be of low amount, be limited to frequencies where most construction noise is centered (below 2 kHz) and we would expect hearing sensitivity returning to pre-exposure levels shortly after migrating through the area.

Foundation installation impact pile driving source levels would be loud; however, we anticipate any whale exposed to pile driving noise would be receiving low levels (closer to the 160 dB rms level than source levels) and be at relatively greater distances given the proposed mitigation measures. As described in the Potential Effects to Marine Mammals and Their Habitat section, the distance of the receiver to the source influences the severity of response with greater distances typically eliciting less severe responses. Additionally, NMFS recognizes North Atlantic right whales migrating could be pregnant females (in the fall) and cows with older calves (in spring) and that these animals may slightly alter their migration course in response to any foundation pile driving; however, as described in the Potential Effects to Marine Mammals and Their Habitat section, we anticipate that course diversion would be of small magnitude. Hence, while some avoidance of the pile driving activities may occur, we anticipate any avoidance behavior would be similar to that of gray whales and be on the order of a couple hundreds of meters up to 1 km. This diversion from a path otherwise uninterrupted by Ocean Wind activities is not expected to result in meaningful energetic costs that would impact annual rates of recruitment of survival. Evidence suggests that in no case would a North Atlantic right whale abandon its migratory behavior. NMFS expects that North Atlantic right whales would be able to avoid areas during periods of active noise production, while not being forced out of important migratory habitat.

North Atlantic right whale presence in the Ocean Wind 1 project area is year-round; however, abundances during summer months are low compared to the winter months with spring and fall serving as ''shoulder seasons,'' wherein abundance waxes (fall) or wanes (spring). Given this year-round habitat usage and in recognition that where and when whales may actually occur during project activities is unknown as it depends on the annual migratory behaviors, the applicant has proposed and NMFS is proposing to require a suite of mitigation measures designed to reduce impacts to North Atlantic right whales to the maximum extent practicable. These mitigation measures (*e.g.,* vessel separation distances, reduced speed) would not only avoid the likelihood of ship strikes, but also would minimize the severity of behavioral disruptions by minimizing impacts (*e.g.,* through sound reduction using abatement systems). This would further ensure that the relatively small number of Level B harassment takes that are estimated to occur are not expected to affect reproductive success or survivorship via detrimental impacts to energy intake or calf/calf interactions during migratory transit. However, even in consideration of these recent habitat-use and distribution shifts, Ocean Wind would be installing monopiles when the presence of North Atlantic right whales is lower (compared to winter).

As described in the Description of Marine Mammals in the Area of Specified Activities section, Ocean Wind 1 would be constructed within the North Atlantic right whale migratory corridor BIA which represent areas and months within which a substantial portion of a species or population is known to migrate. The Ocean Wind 1 project area is relatively small compared with the migratory BIA area (approximately 277 km^2 against the size of the full North Atlantic right whale migratory BIA at 269,448 km^2). Because of this, any North Atlantic right whales that may be encountered during the Ocean Wind 1 project would be expected to be migrating through the area. There are no known North Atlantic right whale mating or calving areas within the project area. The primary foraging habitat for North Atlantic right whales is located further north (391 km (243 mi) away from the lease area). However, if foraging events did occur, these would likely be sporadic and not focused specifically in the project area. In any case, it is unlikely dedicated foraging activities in this area would occur often, much less consistently the same hours when impact pile driving is planned to occur. Impact driving, which is responsible for the majority of North Atlantic right whale impacts, would be limited to a maximum of eight hours per day (intermittent two four-hour events); therefore, if foraging activity is disrupted due to pile driving, any disruption would be brief as North Atlantic right whales would likely resume foraging after pile driving ceases or when animals move to another location to forage. Prey species are mobile (*e.g.,* calanoid copepods can initiate rapid and directed escape responses) and are broadly distributed throughout the project area (noting again that North Atlantic right whale prey is not concentrated in the project area); therefore, any impacts to prey that may occur are also unlikely to impact marine mammals. However, given the project area is in the migratory corridor and not a dedicated foraging ground, animals are more likely to be transiting through and not engaging in concentrated, frequent foraging behavior.

The most significant measure to minimize impacts to individual North Atlantic right whales during monopile installations is the seasonal moratorium on impact pile driving of monopiles from January 1 through April 30, when North Atlantic right whale abundance in the project area is expected to be greatest. NMFS also expects this measure to greatly reduce the potential for mother-calf pairs to be exposed to impact pile driving noise above the Level B harassment threshold during their annual spring migration through the project area from calving grounds to foraging grounds. Further, NMFS expects that exposures to North Atlantic right whales would be reduced due to the additional proposed mitigation measures that would ensure that any exposures above the Level B harassment threshold would result in only short-term effects to individuals exposed. Impact pile driving of monopiles is limited to two piles per day and may only begin in the absence of North Atlantic right whales (any visual detection by PSOs and if detected in a PAM clearance zone). If impact pile driving has commenced, NMFS anticipates North Atlantic right whales would avoid the area, utilizing nearby waters to carry on behavior pre-exposure. However, impact pile driving must be shutdown if a North Atlantic right whale is sighted at any distance, unless a shutdown is not feasible due to risk of injury or loss of life. Shutdown may occur anywhere within or beyond the Level B harassment zone, further minimizing the duration and intensity of exposure. NMFS anticipates that if North Atlantic right whales go undetected and they are exposed to impact pile driving noise it is unlikely a North Atlantic right whale would approach the impact pile driving locations to the degree that they would purposely expose themselves to very high noise levels. These measures are designed to avoid PTS and also reduce the severity of Level B harassment, including the potential for TTS. While some TTS could occur, given the proposed mitigation measures (*e.g.,* delay pile driving upon a sighting or acoustic detection and shutting down upon a sighting or acoustic detection), the potential for TTS to occur is low.

The proposed clearance and shutdown measures are most effective when detection efficiency is maximized as the measures are triggered by a sighting or acoustic detection. To maximize detection efficiency, Ocean Wind proposed, and NMFS is proposed to require the combination of PAM and visual observers (as well as communication protocols with other Ocean Wind vessels, and other heightened awareness efforts such as daily monitoring of North Atlantic right whale sighting databases) such that as a North Atlantic right whale approaches the source (and thereby could be exposed to higher noise energy levels), PSO detection efficacy will increase, the whale will be detected, and a delay to commencing pile driving or shutdown (if feasible) will occur. In addition, the implementation of a soft start will provide an opportunity for whales to move away from the source if they are undetected, reducing received levels. Further, Ocean Wind has committed to not installing two WTG or OSS foundations simultaneously. North Atlantic right whales would, therefore, not be exposed to concurrent impact pile driving on any given day and the area ensonified at any given time would be limited. We note that Ocean Wind has requested to install foundation piles at night which does raise concern over detection capabilities. Ocean Wind is currently conducting detection capability studies using alternative technology and intends to submit the results of that study to NMFS. In consultation with BOEM, NMFS will review the results and determine if Ocean Wind should be allowed to conduct pile driving at night.

Although temporary cofferdam Level B harassment zones are large (10 km to the unweighted Level B harassment threshold; Table 1–24 in the ITA application), the cofferdams would be installed nearshore over a short timeframe (36 hours total; 18 hours for installation and 18 hours for removal), with the closest cofferdam (BL England) approximately 24.18 km (15.02 mi) away from the Lease Area. Therefore, it is also unlikely that any North Atlantic right whales would be exposed to concurrent vibratory and impact pile installation noises. Any UXO/MEC detonations, if determined to be necessary, would only occur in daylight and if all other low-order methods or removal of the explosive equipment of the device are determined to not be possible. Given that specific locations for the ten possible UXOs/MECs are not presently known, Ocean Wind has agreed to undertake specific mitigation measures to reduce impacts on any North Atlantic right whales, including the use of a sound attenuation device (*i.e.,* likely a bubble curtain and another device) to a minimum of 10 dB and not detonating a UXO/MEC is a North Atlantic right whale is observed within an exclusion zone. The area around the detonation would be monitored effectively using at least 2 dedicated PSO vessels or a vessel and aerial platform. Finally, for HRG surveys, the maximum distance to the Level B harassment isopleth is 141 m. The estimated take, by Level B harassment only, associated with construction surveys is to account for any North Atlantic right whale PSOs may miss when HRG acoustic sources are active. However, because of the short maximum distance to the Level B harassment isopleth (141 m), the requirement that vessels maintain a distance of 500 m from any North Atlantic right whales, and the whales are unlikely to remain in close proximity to a construction survey vessel for any length of time, any exposure to noise levels about harassment threshold if any, would be very brief as the source would be turned off upon detection. To further minimize exposure, ramp-up of boomers, sparkers, and CHIRPs must be delayed during the clearance period if PSOs detect a North Atlantic right whale (or any other ESA-listed species) within 500 m of the acoustic source. Operation of this equipment (if active) must be shut down if a North Atlantic right whale is sighted within 500 m. With implementation of the proposed mitigation requirements, take by Level A harassment is unlikely and is therefore not proposed for authorization. Potential impacts associated with Level B harassment would include low-level, temporary behavioral modifications, most likely in the form of avoidance behavior or potential alteration of vocalizations (due to masking). Given the high level of precautions taken to minimize both the amount and intensity of Level B harassment take on marine mammals and because the exposures will not occur in areas or at times where impacts would be likely to affect feeding and energetics or calving (given this is a migratory corridor), it is unlikely that the anticipated low level exposures could lead to reduced reproductive success or survival.

Altogether, North Atlantic right whales are listed as endangered under the ESA with a declining population primarily due to vessel strike and entanglement. Only five instances of take, by Level B harassment only, are estimated to occur annually within a migratory corridor and 14 instance of take over the 5-year effective period of the proposed rule with the likely scenario that each instance of exposure occurs to a different individual (a small portion of the stock), and any individual North Atlantic right whale is likely to be disturbed at a low-moderate level. The low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality, serious injury, or Level A harassment is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the proposed authorized take would have a negligible impact on the North Atlantic stock of North Atlantic right whales.

Humpback Whales

Humpback whales potentially impacted by Ocean Wind's activities do not belong to a DPS that is listed as threatened or endangered under the ESA. However, humpback whales along the Atlantic Coast have been experiencing an active UME as elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through Florida since January 2016. Of the cases examined, approximately half had evidence of human interaction (ship strike or entanglement). The UME does not yet provide cause for concern regarding population-level impacts. Despite the UME, the relevant population of humpback whales (the West Indies breeding population, or DPS of which the Gulf of Maine stock is a part) remains stable at approximately 12,000 individuals.

Ocean Wind has requested, and NMFS has proposed to authorize, a limited amount of humpback whale harassment. No mortality or serious injury is anticipated or proposed to be authorized. Similar to North Atlantic right whales, impact pile driving (assuming the joint-monopile and pin pile build-out) has the potential to result in the highest amount of annual take (6 Level A harassment and 21 Level B harassment takes) and is of greatest concern given loud source levels. As described in the Description of Marine Mammals in the Area of Specified Activities section, Brown *et al.* (2022) found that mean humpback whale occurrence offshore of New Jersey was low (2.5 days), mean occupancy was 37.6 days, and 31.3 percent of whales returned from one year to the next. The majority of whales were seen during summer (July–September, 62.5 percent), followed by autumn (October–December, 23.5 percent) and spring (April–June, 13.9 percent). These data suggest that of the 21 maximum annual instances of predicted to take by Level B harassment, they could consist either of individuals exposed to levels above the Level B harassment threshold once during migration and/or individuals exposed on 2 or 3 days to activities conducted by Ocean Wind (primarily impact or vibratory pile driving and HRG surveys during months in which they are abundant), and we note that any such exposures would not be occurring continuously throughout the days. Animals exposed are likely to be juveniles and while they may be foraging (primary foraging grounds occur in more northern latitudes), they are likely migrating through the area.

For all the reasons described in the Mysticete section above, we anticipate any PTS or TTS to be small (limited to a few dB) and be concentrated at half or one octave above the frequency band of pile driving noise (most sound is below 2 kHz) which does not include the full predicted hearing range of baleen whales. If TTS is incurred, hearing sensitivity would likely return to pre-exposure levels shortly after exposure ends. Any masking or physiological responses would also be of low magnitude and severity for reasons described above.

Altogether, the amount of take proposed to be authorized is small and the low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the proposed authorized take would have a negligible impact on the Gulf of Maine stock of humpback whales.

Blue, Sei, and Fin Whales

The Western North Atlantic stocks of blue and fin whales and the Nova Scotia stock of sei whales are all listed under the ESA. There are no known areas of specific biological importance in or around the project area, nor are there any UMEs. For all three stocks, the actual abundance of each stock is likely significantly greater than what is reflected in each SAR because, as noted in the SARs, the most recent population estimates are primarily based on surveys conducted in U.S. waters and all three stocks' range extends well beyond the U.S. EEZ.

Regarding the magnitude of take, the maximum number of annual and 5-year total estimated harassment takes for all three species is very low: 4, 3, and 13 takes by Level B harassment of blue, sei, and fin whales respectively, with 4 and 1 potential Level A harassment takes for fin and sei whales. Similarly to other mysticetes, we would anticipate the number of takes to represent individuals taken only once or, in rare cases, an individual taken a very small number of times as most whales in the project area would be migrating. Regarding the severity of those individual takes by behavioral Level B harassment, we would anticipate impacts to be limited to low-level, temporary behavioral responses with avoidance and potential masking impacts in the vicinity of the turbine installation to be the most likely type of response (similar to other migrating mysticetes). Any avoidance distances would be expected to be relatively limited. We are also proposing to authorize a very small amount of Level A harassment takes in the form of PTS to fin whales and sei whales (4 and 1 takes, respectively). As with other mysticetes, we anticipate the mitigation measures employed and avoidance behavior would reduce the severity of PTS such that any threshold shift would be small and be limited to the frequencies in which impact pile driving contains the most energy which does not overlap with the entire hearing range of these species.

Overall, the take by harassment proposed to be authorized is of a low magnitude and severity and is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the proposed authorized take would have a negligible impact on the Western North Atlantic blue whale and fin whales stocks and the Nova Scotia sei whale stock.

Minke Whales

Beginning in January 2017, elevated minke whale strandings have occurred along the Atlantic coast from Maine through South Carolina, with highest numbers in Massachusetts, Maine, and New York. This event does not provide cause for concern regarding population level impacts, as the likely population abundance is greater than 20,000 whales. No mortality or serious injury of this stock is anticipated or proposed for authorization.

Minke whales may be taken by Level A and Level B harassment; however, this would be limited to a low number of individuals annually (22 and 74, respectively). We anticipate the impacts of this harassment to follow that described in the general Mysticete section above. In summary, any PTS would be of small amount not expected to impact individual fitness. Level B harassment would be temporary with primary impacts being temporary displacement of the project area but not abandonment of any migratory behavior. Overall, the amount of take proposed to be authorized is small and the low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the proposed authorized take would have a negligible impact on the Gulf of Maine stock of humpback whales.

Odontocetes

In this section, we include information here that applies to all of the odontocete species and stocks addressed below, which are further divided into the following subsections: Sperm whales, Dolphins and small whales; and Harbor porpoise. These sub-sections include more specific information about the group, as well as conclusions for each stock represented.

The majority of takes by harassment of odontocetes incidental to Ocean Wind 1 specified activities are by Level B harassment from pile driving and HRG surveys. We anticipate that, given ranges of individuals (*i.e.,* that some individuals remain within a small area for some period of time), and non-migratory nature of some odontocetes in general (especially as compared to mysticetes), these takes are more likely to represent multiple exposures of a smaller number of individuals than is the case for mysticetes, though some takes may also represent one-time exposures to an individual.

Pile driving, particularly impact pile driving foundation piles, has the potential to disturb odontocetes to the greatest extent compared to HRG surveys and UXO/MEC detonations. We expect animals to avoid the area during pile driving; however, their habitat range is extensive compared to the area ensonified during pile driving.

As described earlier, Level B harassment may manifest as changes to behavior (*e.g.,* avoidance, changes in vocalizations (from masking) or foraging); physiological responses, or TTS. Odontocetes are highly mobile species and, similar to mysticetes, would expect any avoidance behavior to be limited to the area near the pile being driven. While masking could occur during pile driving, it would only occur in the vicinity of and during the duration of the pile driving, and would not generally occur in a frequency range that overlaps communication or echolocation signals. The mitigation measures (*e.g.,* use of sound abatement systems, implementation of clearance and shutdown zones) would also minimize received levels such that the severity of any behavioral response would be expected to be less than exposure to unmitigated noise exposure.

Any masking or TTS effects is also anticipated to be of low-severity. First, the frequency range of pile driving, the most impactful activity conducted by Ocean Wind in terms of response severity, falls within the range of most odontocete vocalizations. However, odontocete vocalizations span a much wider range than the low frequency construction activities proposed by Ocean Wind. Further, as described above, recent studies suggest odontocetes have a mechanism to self-mitigate (*i.e.,* reduce hearing sensitivity) the impacts of noise exposure. Any masking or TTS is anticipated to be limited and would typically only interfere with communication within a portion of an odontocete's range and as discussed earlier, the effects would only be expected to be of a short duration and, for TTS, a relatively small degree. Furthermore, odontocete echolocation occurs predominantly at frequencies significantly higher than low frequency construction activities; therefore, there is little likelihood that threshold shift, either temporary or permanent would interfere with feeding behaviors (noting that take by Level A harassment (PTS) is proposed for only two species: bottlenose dolphins and harbor porpoise. For HRG surveys, the sources operate at higher frequencies that pile driving and UXO/MEC detonations; however, sound from these sources attenuate very quickly in the water column, as described above, therefore any potential for TTS and masking is very limited. Further, odontocetes (*e.g.,* common dolphins, spotted dolphins, bottlenose dolphins) have demonstrated an affinity to bow-ride actively surveying HRG surveys; therefore, the severity of any harassment, if it does occur, is anticipated to be minimal.

The waters off the coast of New Jersey are used by several odontocete species; however, none (except the sperm whale) are listed under the ESA and there are no known habitats of particular importance. In general, odontocete habitat ranges are far-reaching along the Atlantic coast of the U.S. and the waters off of New Jersey do not contain any unique features that make up the project area.

Sperm Whale

The Western North Atlantic stock of sperm whales spans the East Coast out into oceanic waters well beyond the U.S. EEZ. Although listed as endangered, the primary threat faced by the sperm whale (*i.e.,* commercial whaling) has been eliminated and, further, sperm whales in the western North Atlantic were little affected by modern whaling (Taylor *et al.,* 2008). Current potential threats to the species globally include vessel strikes, entanglement in fishing gear, anthropogenic noise, exposure to contaminants, climate change, and marine debris. There is no currently reported trend for the stock and, although the species is listed as endangered under the ESA, there are no specific issues with the status of the stock that cause particular concern *(e.g.,* no UMEs). There are no known areas of biological importance (*e.g.,* critical habitat or BIAs) in or near the project area.

No mortality, serious injury or Level A harassment is anticipated or proposed to be authorized for this species. Impacts would be limited to Level B harassment and would occur to only a very small number of individuals (maximum of 6 per year or 18 across all 5 years) incidental to pile driving, UXO/MEC detonation(s), and HRG surveys. Sperm whales are not common within the project area due to the shallow waters and it is not expected any noise levels would reach habitat in which sperm whales are common, including deep-water foraging habitat. If sperm whales do happen to be present in the project area during any activities related to Ocean Wind 1, they would likely be only transient visitors and not engaging in any significant behaviors. This very low magnitude and severity of effects is not expected to result in impacts on the reproduction or survival of individuals, much less impact annual rates of recruitment or survival. For these reasons, we have determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the take proposed to be authorized would have a negligible impact on sperm whales.

Dolphins and Small Whales (Including Delphinids, Pilot Whales, and Harbor Porpoises)

There are no specific issues with the status of odontocete stocks that cause particular concern (*e.g.,* no recent UMEs). No mortality or serious injury is expected nor proposed to be authorized for these stocks. With the exception of 11 takes by Level A harassment proposed for the coastal stock of bottlenose dolphins as a precaution in the event that a pod approaches the cofferdams during either installation or removal activities, only Level B harassment is anticipated or proposed for authorization for any dolphin or small whale.

The maximum amount of Level B harassment take proposed for authorization within any one year for all odontocetes cetacean stocks ranges from 100 to 1,645 instances, which is less than 2.5 percent as compared to the population size for all stocks, with the exception of coastal bottlenose dolphins, for which the estimate is closer to 25 percent, if each instance were considered a take of a separate individual. As described above for odontocetes broadly, we anticipate that a fair number of these instances of take in a day represent multiple exposures of a smaller number of individuals, meaning the actual number of individuals taken is lower. Although some amount of repeated exposures to some individuals are likely given the duration of activity proposed by Ocean Wind, the intensity of any Level B harassment combined with the availability of alternate nearby foraging habitat suggests that the likely impacts would not impact the reproduction or survival of any individuals.

Ocean Wind has requested, and we proposed to authorize, 11 instances of Level A harassment in the form of PTS to the northern coastal stock of bottlenose dolphins due to vibratory pile driving of temporary cofferdams using sheet piles. We anticipate the mitigation measures employed and avoidance behavior by this species would reduce the severity of PTS such that any threshold shift would be small and be limited to half or one octave above the frequencies in which vibratory pile driving contains the most energy (below 2 kHz) which would only overlap a relatively small portion of the hearing range of these species. In general, any small amount of PTS incurred in the noted frequency range is unlikely to interfere significantly with dolphin vocalization or echolocation abilities and, as such, is not anticipated to impact survival or reproduction of any individual.

The western North Atlantic northern migratory coastal stock of bottlenose dolphins is not listed under the ESA but is strategic given its depleted status under the MMPA. The stock has, in the past, been subject to UMEs. An analysis of coast-wide (New Jersey to Florida) trends in abundance for common bottlenose dolphins based on aerial surveys conducted between 2002 and 2016. There was no significant trend in population size between 2002 and 2011; however, between 2011 and 2016, there was a significant difference in slope indicating a decline in population size. NMFS identified the 2013–2015 UME as a cause for this decline which is no longer a threat. There have been no UMEs since 2015 and there are no active UMEs impacting this stock.

The amount of take authorized for this stock constitutes the largest total percentage of exposures in comparison with the stock abundance (total of 24.78 percent based on the maximum take in any one year). Ocean Wind has requested, and we have proposed to authorize, 1,643 instances of Level B harassment. However, the number of individuals taken is highly likely to be a combination of repeat exposures to the same individual or single exposures to individuals; therefore the amount of individuals taken represent a smaller percentage of the population than the number of exposures. The majority of exposures (1,031 instances of Level B harassment; total of 15.5 percent) is due to vibratory pile driving to install cofferdams which will likely elicit less severe responses than impact pile driving or UXO/MEC detonation given lower source levels. The potential effects from exposure to any of Ocean Wind's pile driving, UXO/MEC detonation or HRG survey activities are likely to be temporary avoidance of the area, changes to behavior such as vocalizing (due to masking) or foraging, and potential TTS. No Level A harassment (in the form of PTS or other injury (from UXO/MEC detonation)) is anticipated or proposed to be authorized. Cofferdam installation would be relatively brief compared to other project activities (a maximum of 12 hours of vibratory installation/removal per day within any 24-hour period). Given the temporary nature and minimal severity of the effects, NMFS does not expect that, collectively, the activities proposed would impact the reproduction or survival of any individuals, or the population collectively through the annual rates of recruitment and survival.

Overall, the populations of all dolphins and small whale species and stocks for which we propose to authorize take are stable (no declining population trends), not facing existing UMEs, and the small amount, magnitude and severity of effects is not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the take proposed to be authorized would have a negligible impact on all dolphin and small whale species and stocks considered in this analysis.

Harbor Porpoises

The Gulf of Maine/Bay of Fundy stock of harbor porpoise is found predominantly in northern U.S. coastal waters (less than 150 m depth) and up into Canada's Bay of Fundy. Although the population trend is not known, there are no UMEs or other factors that cause particular concern for this stock. No mortality or non-auditory injury by UXO/MEC detonation are anticipated or authorized for this stock. We propose to authorize 350 takes by Level B harassment and 69 takes by Level A harassment.

Regarding the severity of those individuals taken by behavioral Level B harassment, because harbor porpoises are particularly sensitive to noise, it is likely that a fair number of the responses could be of a moderate nature, particularly to pile driving. In response to pile driving, harbor porpoises are likely to avoid the area during construction, as previously demonstrated in Tougaard *et al.* (2009) in Denmark, in Dahne *et al.* (2013) in Germany, and in Vallejo *et al.* 2017 in the United Kingdom, although a study by Graham *et al.* (2019) may indicate that the avoidance distance could decrease over time. However, pile driving is scheduled to occur when harbor porpoise abundance is low off the coast of New Jersey and given alternative foraging areas, any avoidance of the area by individuals is not likely to impact the reproduction or survival of any individuals. Given only one UXO/MEC would be detonated on any given day and up to only 10 UXO/MEC would be detonated over the 5-year effective period of the LOA, any behavioral response would be brief and of a low severity.

With respect to PTS and TTS, the effects on an individual are likely relatively low given the frequency bands of pile driving (most energy below 2 kHz) compared to harbor porpoise hearing (150 Hz to 160 kHz peaking around 40 kHz). Specifically, PTS or TTS is unlikely to impact hearing ability in their more sensitive hearing ranges, or the frequencies in which they communicate and echolocate. Regardless, we have authorized a limited amount of PTS but expect any PTS that may occur to be within the very low end of their hearing range where harbor porpoises are not particularly sensitive (*i.e.,* any PTS or TTS is unlikely to impact hearing ability in their more sensitive hearing ranges) and any PTS would be of small magnitude. As such, any PTS would not interfere with key foraging or reproductive strategies necessary for reproduction or survival.

In summary, the amount of take proposed to be authorized is small and while harbor porpoises are likely to avoid the area during any construction activity discussed herein, as demonstrated during European wind farm construction, the time of year in which work would occur is when harbor porpoise are not in high abundance and any work would not result in abandonment of the waters off of New Jersey. Any PTS or TTS would occur in the very low ends of harbor porpoise hearing range and be of small magnitude. The low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Ocean Wind's activities combined, that the proposed authorized take would have a negligible impact on the Gulf of Maine/Bay of Fundy stock of harbor porpoise.

Pinnipeds (Harbor Seals and Gray Seals)

Neither of these stocks of harbor seals or gray seals are listed under the ESA. Ocean Wind requested, and NMFS proposes to authorize no more than 35 and 844 harbor seals and 31 and 305 gray seals by Level A and Level B harassment, respectively, within any one year. These species occur in New Jersey waters most often in winter when impact and vibratory pile driving and UXO/MEC detonations would not occur. Seals are also more likely to be close to shore such that exposure to impact pile driving would be expected to be at lower levels generally (but still above NMFS behavioral harassment threshold). The majority of takes of these species' is from vibratory pile driving associated with temporary cofferdam installation and removal from which impacts are expected to be minimal. Research and observations show that pinnipeds in the water may be tolerant of anthropogenic noise and activity (a review of behavioral reactions by pinnipeds to impulsive and non-impulsive noise can be found in Richardson *et al.* (1995) and Southall *et al.* (2007)). Available data, though limited, suggest that exposures between approximately 90 and 140 dB SPL do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water (Costa *et al.,* 2003; Jacobs and Terhune, 2002; Kastelein *et al.,* 2006c). Based on the limited data on pinnipeds in the water exposed to multiple pulses (small explosives, impact pile driving, and seismic sources), exposures in the approximately 150 to 180 dB SPL range generally have limited potential to induce avoidance behavior in pinnipeds (Blackwell *et al.,* 2004; Harris *et al.,* 2001; Miller *et al.,* 2004). Pinnipeds may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Effects on pinnipeds that are taken by Level B harassment in the project area would likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals would simply move away from the sound source and be temporarily displaced from those areas (see Lucke *et al.,* 2006; Edren *et al.,* 2010; Skeate *et al.,* 2012; Russell *et al.,* 2016). Given their documented tolerance of anthropogenic sound (Richardson *et al.,* 1995; Southall *et al.,* 2007), repeated exposures of individuals of any of these species to levels of sound that may cause Level B harassment are unlikely to significantly disrupt foraging behavior. Thus, even repeated Level B harassment across a few days of some small subset of individuals, which could occur, is unlikely to result in impacts on the reproduction or survival of any individuals. Moreover, pinnipeds would benefit from the mitigation measures described in the Proposed Mitigation section.

Ocean Wind requested, and NMFS is proposing to authorize, a small amount of PTS (48 harbor seals and 35 gray seals which constitutes less than 0.1 percent of the populations) incidental to pile driving and UXO/MEC detonation. The majority of PTS is from installing cofferdams which is unlikely to manifest as a large degree of PTS given the nature of vibratory pile driving and we would anticipate seals would move away from the activity prior to a large degree of PTS occurring. As described above, noise from pile driving and UXO/MEC detonation is low frequency and, while any PTS that does occur would fall within the lower end of pinniped hearing ranges (50 Hz to 86 kHz), PTS would not occur at frequencies where pinniped hearing is most sensitive. In summary, any PTS, would be of small degree and not occur across the entire, or even most sensitive, hearing range. Hence, any impacts from PTS are likely to be of low severity and not interfere with behaviors critical to reproduction or survival.

Elevated numbers of harbor seal and gray seal mortalities were first observed in July 2018 and occurred across Maine, New Hampshire, and Massachusetts until 2020. Based on tests conducted so far, the main pathogen found in the seals belonging to that UME was phocine distemper virus, although additional testing to identify other factors that may be involved in this UME are underway. Currently, the only active UME is occurring in Maine with some harbor and gray seals testing positive for highly pathogenic avian influenza (HPAI) H5N1. Although elevated strandings continue, neither UME (alone or in combination) provide cause for concern regarding population-level impacts to any of these stocks. For harbor seals, the population abundance is over 75,000 and annual M/SI (350) is well below PBR (2,006) (Hayes *et al.,* 2020). The population abundance for gray seals in the United States is over 27,000, with an estimated abundance, including seals in Canada, of approximately 450,000. In addition, the abundance of gray seals is likely increasing in the U.S. Atlantic as well as in Canada (Hayes *et al.,* 2020).

Overall, impacts from the Level B harassment take proposed to be authorized incidental to Ocean Wind's specified activities would be of relatively low magnitude and a low severity. Similarly, while some individuals may incur PTS overlapping some frequencies that are used for foraging and communication, given the low degree, the impacts would not be expected to impact reproduction or survival of any individuals. In consideration of all of the effects of Ocean Wind's activities combined, we have preliminarily determined that the authorized take will have a negligible impact on harbor seals and gray seals.

Preliminary Negligible Impact Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the specified activities will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. When the predicted number of individuals to be taken is less than one third of the species or stock abundance, the take is considered to be of small numbers. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

NMFS proposes to authorize incidental take (by Level A and B harassment) of 17 species of marine mammal (with 18 managed stocks). The maximum number of takes possible within any one year and proposed for authorization relative to the best available population abundance is low for all species and stocks potentially impacted (*i.e.,* less than 3 percent for 17 stocks, and less than 25 percent for 1 other stock; see Table 36). Therefore, NMFS preliminarily finds that small numbers of marine mammals may be taken relative to the estimated overall population abundances for those stocks.

Based on the analysis contained herein of the proposed action (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals would be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Adaptive Management

The regulations governing the take of marine mammals incidental to Ocean Wind's construction activities would contain an adaptive management component. The reporting requirements associated with this rule are designed to provide NMFS with monitoring data from completed projects to allow consideration of whether any changes are appropriate. The use of adaptive management allows NMFS to consider new information from different sources to determine (with input from Ocean Wind regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammals and if the measures are practicable.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: (1) Results from monitoring reports, as required by MMPA authorizations; (2) results from general marine mammal and sound research; and (3) any information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOA. During the course of the rule, Ocean Wind (and other LOA-holders conducting offshore wind development activities) would be required to participate in one or more adaptive management meetings convened by NMFS and/or BOEM, in which the above information would be summarized and discussed in the context of potential changes to the mitigation or monitoring measures.

Endangered Species Act (ESA)

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. 1531 *et seq.*) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the promulgation of rulemakings, NMFS consults internally whenever we propose to authorize take for endangered or threatened species, in this case with the NMFS Greater Atlantic Regional Field Office (GARFO).

The NMFS Office of Protected Resources is proposing to authorize the take of five marine mammal species, which are listed under the ESA: the North Atlantic right, sei, fin, blue, and sperm whale. The Permit and Conservation Division has requested initiation of Section 7 consultation on September 12, 2022 with GARFO for the issuance of this proposed rulemaking. NMFS will conclude the Endangered Species Act consultation prior to reaching a determination regarding the proposed issuance of the authorization. The proposed regulations and any subsequent LOA(s) would be conditioned such that, in addition to measures included in those documents, the applicant would also be required to abide by the reasonable and prudent measures and terms and conditions of a Biological Opinion and Incidental Take Statement, issued by NMFS, pursuant to Section 7 of the Endangered Species Act.

Proposed Promulgation

As a result of these preliminary determinations, NMFS proposes to promulgate an ITR for Ocean Wind authorizing take, by Level A and B harassment, incidental to construction activities associated with the Ocean Wind 1 offshore wind facility offshore of New Jersey for a five-year period from August 1, 2023 through July 31, 2028, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed rulemaking can be found at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility*.

Request for Additional Information and Public Comments

NMFS requests interested persons to submit comments, information, and suggestions concerning Ocean Wind's request and the proposed regulations (see **ADDRESSES**). All comments will be reviewed and evaluated as we prepare the final rule and make final determinations on whether to issue the requested authorization. This document and referenced documents provide all environmental information relating to our proposed action for public review.

Classification

Pursuant to the procedures established to implement Executive Order 12866, the Office of Management and Budget has determined that this proposed rule is not significant.

Pursuant to section 605(b) of the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. Ocean Wind is the sole entity that would be subject to the requirements in these proposed regulations, and Ocean Wind is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Under the RFA, governmental jurisdictions are considered to be small if they are ''. . .governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than 50,000. . . .'' As of the 2020 census, Atlantic County, NJ, the county containing Atlantic City, NJ, had a population of nearly 275,000 people. Because of this certification, a regulatory flexibility analysis is not required and none has been prepared.

Notwithstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act (PRA) unless that collection of information displays a currently valid OMB control number. These requirements have been approved by OMB under control number 0648–0151 and include applications for regulations, subsequent LOA, and reports. Send comments regarding any aspect of this data collection, including suggestions for reducing the burden, to NMFS.

NMFS has determined that activities requiring an authorization for the incidental, but not intentional, take of small numbers of marine mammals on the outer continental shelf are re not within or would not affect a state's coastal zone, and thus do not require a NMFS consistency determination under 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. 1456 (c)(3)(A), and associated regulations codified at 15 CFR 930, subpart D, and are not contingent on a state's concurrence. Activities requiring an authorization for the incidental take of small numbers of marine mammals are deemed an unlisted activity under 15 CFR 930.54. Pursuant to section 101(a)(5)(A) of the MMPA, NMFS is publishing notice of the proposed incidental take regulation and requests public comment. If the state wants to review the unlisted activity under the CZMA, then it must submit an unlisted activity review request to the Director of NOAA's Office for Coastal Management within 30 days from the date of publication of this document (see **DATES** section for exact dates), and notify the applicant and NMFS that it intends to review the proposed activity. If the request is not submitted within the 30 days, the state's opportunity to review the unlisted activity will be considered waived. Conversely, if the state timely submits an unlisted activity review request and the Director of the Office for Coastal Management approves the request, then the applicant must submit a consistency certification to the state for review. In the latter instance, NMFS will not issue the incidental take authorization until the state provides concurrence that the proposed activity is consistent with the state coastal management program or until concurrence by the state agency is presumed (due to the state's failure to respond within the required timeframe). See 15 CFR 930.54(d) and (e).

List of Subjects in 50 CFR Part 217

Administrative practice and procedure, Endangered and threatened species, Exports, Fish, Fisheries, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation, Wildlife.

Dated: October 20, 2022.

Samuel D. Rauch III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, NMFS proposes to amend 50 CFR part 217 as follows:

PART 217—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS INCIDENTAL TO SPECIFIED ACTIVITIES

■ 1. The authority citation for part 217 continues to read:

Authority: 16 U.S.C. 1361 *et seq,* unless otherwise noted.

■ 2. Add subpart AA, consisting of §§ 217.260 through 217.269, to read as follows:

Subpart AA—Taking Marine Mammals Incidental to Construction of the Ocean Wind 1 Wind Energy Facility Offshore of New Jersey

Sec.

Subpart AA—Taking Marine Mammals Incidental to Construction of the Ocean Wind 1 Wind Energy Facility Offshore of New Jersey

§ 217.260 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the taking of marine mammals that occurs incidental to activities associated with construction of the Ocean Wind 1 Wind Energy Facility by Ocean Wind, LLC (Ocean Wind), a subsidiary of Orsted Wind Power North America, LLC's (Orsted) and a joint venture partner of the Public Service Enterprise Group Renewable Generation, LLC (PSEG), and those persons it authorizes or funds to conduct activities on its behalf in the area outlined in paragraph (b) of this section.

(b) The taking of marine mammals by Ocean Wind may be authorized in a Letter of Authorization (LOA) only if it occurs in the Bureau of Ocean Energy Management (BOEM) Lease Area Outer Continental Shelf (OCS)–A–0498 Commercial Lease of Submerged Lands for Renewable Energy Development and along export cable routes at sea-to-shore transition points at BL England and Oyster Creek.

(c) The taking of marine mammals by Ocean Wind is only authorized if it occurs incidental to the following activities associated with the Ocean Wind 1 Wind Energy Facility:

(1) Installation of wind turbine generators (WTG) and offshore substation (OSS) foundations by impact pile driving;

(2) Installation of temporary cofferdams by vibratory pile driving;

(3) High-resolution geophysical (HRG) site characterization surveys; and

(4) Detonation of unexploded ordnances or munitions and explosives of concern (UXOs/MECs).

§ 217.261 Effective dates.

Regulations in this subpart are effective from August 1, 2023, through July 31, 2028.

§ 217.262 Permissible methods of taking.

Under an LOA, issued pursuant to this section and § 217.266, Ocean Wind, and those persons it authorizes or funds to conduct activities on its behalf, may incidentally, but not intentionally, take marine mammals within the area described in § 217.260(b) in the following ways, provided Ocean Wind is in complete compliance with all terms, conditions, and requirements in this subpart and the appropriate LOA:

(a) By Level B harassment associated with the acoustic disturbance of marine mammals by impact pile driving (WTG and OSS monopile and/or jacket foundation installation), vibratory pile installation and removal of temporary cofferdams, the detonation of UXOs/MECs, and through HRG site characterization surveys.

(b) By Level A harassment, provided take is associated with impact pile driving or UXO/MEC detonations.

(c) The incidental take of marine mammals by the activities listed in paragraphs (a) and (b) of this section is limited to the species in the following table.

TABLE 1 TO PARAGRAPH (c)

Marine mammal species	Scientific name	Stock
Blue whale	*Balaenoptera musculus*	Western North Atlantic.
Fin whale	*Balaenoptera physalus*	Western North Atlantic.
Sei whale	*Balaenoptera borealis*	Nova Scotia.
Minke whale	*Balaenoptera acutorostrata*	Canadian East Stock.
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic.
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine.
Sperm whale	*Physeter macrocephalus*	North Atlantic.
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic.
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic.
Bottlenose dolphin	*Tursiops truncatus*	Northern Migratory Coastal.
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Offshore.
Common dolphin	*Delphinus delphis*	Western North Atlantic.
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy.
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic.
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic.
Risso's dolphin	*Grampus griseus*	Western North Atlantic.
Gray seal	*Halichoerus grypus*	Western North Atlantic.
Harbor seal	*Phoca vitulina*	Western North Atlantic.

§ 217.263 Prohibitions.

Except for the takings described in § 217.262 and authorized by an LOA issued under §§ 217.266 and 217.267, it is unlawful for any person to do any of the following in connection with the activities described in § 217.260:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or an LOA issued under §§ 217.266 and 217.267;

(b) Take any marine mammal not specified in table 1 to § 217.262(c);

(c) Take any marine mammal specified in the LOA in any manner other than as specified; or

(d) Take any marine mammal specified in table 1 to § 217.262(c) if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammals.

(e) [Reserved]

§ 217.264 Mitigation requirements.

When conducting the activities identified in § 217.260(c) the mitigation measures contained in any LOA issued under § 217.266 must be implemented. These mitigation measures must include, but are not limited to:

(a) *General conditions.* (1) A copy of any issued LOA must be in the possession of Ocean Wind and its designees, all vessel operators, visual and acoustic protected species observers (PSOs)/passive acoustic monitoring (PAM) operators, pile driver operator, and any other relevant designees operating under the authority of the issued LOA;

(2) Ocean Wind must conduct briefings between construction supervisors, construction crews, and the PSO/PAM team prior to the start of all construction activities (as described in § 217.260), and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring and reporting protocols, and operational procedures. An informal guide must be included with the Marine Mammal Monitoring Plan to aid personnel in identifying species if they are observed in the vicinity of the project area;

(3) Ocean Wind must ensure that any visual observations of an ESA-listed marine mammal are communicated to PSOs and vessel captains during the concurrent use of multiple project-associated vessels (of any size; *e.g.,* construction surveys, crew/supply transfers, *etc.*);

(4) If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone for each specified activity, impact and vibratory pile driving activities and HRG acoustic sources must be shut down immediately, unless shutdown is not practicable, or be delayed if the activity has not commenced. Impact and vibratory pile driving, UXO/MEC detonation, and initiation of HRG acoustic sources must not commence or resume until the animal(s) has been

confirmed to have left the relevant clearance zone or the observation time has elapsed with no further sightings. UXO/MEC detonations may not occur until the animal(s) has been confirmed to have left the relevant clearance zone or the observation time has elapsed with no further sightings;

(5) Prior to and when conducting any in-water construction activities and vessel operations, Ocean Wind personnel (*e.g.,* vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the project area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (*i.e.,* Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators and PSOs;

(6) Any marine mammals observed within a clearance or shutdown zone must be allowed to remain in the area (*i.e.,* must leave of their own volition) prior to commencing impact and vibratory pile driving activities or construction surveys; and

(7) Any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale.

(b) *Vessel strike avoidance measures.* (1) Prior to the start of construction activities, all vessel operators and crew must receive a protected species identification training that covers, at a minimum:

(i) Sightings of marine mammals and other protected species known to occur or which have the potential to occur in the Ocean Wind 1 project area;

(ii) Training on making observations in both good weather conditions (*i.e.,* clear visibility, low winds, low sea states) and bad weather conditions (*i.e.,* fog, high winds, high sea states, with glare);

(iii) Training on information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species;

(iv) Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities; and

(v) Confirmation of marine mammal observer training (including an understanding of the LOA requirements) must be documented on a training course log sheet and reported to NMFS.

(2) All vessels must abide by the following:

(i) All vessel operators and crews, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any marine mammal;

(ii) All vessels must have a visual observer on board who is responsible for monitoring the vessel strike avoidance zone for marine mammals. Visual observers may be PSO or crew members, but crew members responsible for these duties must be provided sufficient training by Ocean Wind to distinguish marine mammals from other phenomena and must be able to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine mammal. Crew members serving as visual observers must not have duties other than observing for marine mammals while the vessel is operating over 10 kts;

(iii) Year-round, all vessel operators must monitor, the project's Situational Awareness System, WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales once every 4-hour shift during project-related activities. The PSO and PAM operator monitoring teams for all activities must also monitor these systems no less than every 12 hours. If a vessel operator is alerted to a North Atlantic right whale detection within the project area, they must immediately convey this information to the PSO and PAM teams. For any UXO/MEC detonation, these systems must be monitored for 24 hours prior to blasting;

(iv) Any observations of any large whale by any Ocean Wind staff or contractor, including vessel crew, must be communicated immediately to PSOs and all vessel captains to increase situational awareness;

(v) All vessels must comply with existing NMFS vessel speed regulations, as applicable, for North Atlantic right whales;

(vi) Between November 1st and April 30th, all vessels, regardless of size, must operate at 10 kts or less when traveling between ports in New Jersey, New York, Maryland, Delaware, and Virginia;

(vii) All vessels, regardless of size, must immediately reduce speed to 10 kts or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed (within 500 m) of an underway vessel;

(viii) All vessels, regardless of size, must immediately reduce speed to 10 kts or less when a North Atlantic right whale is sighted, at any distance, by anyone on the vessel;

(ix) If a vessel is traveling at greater than 10 knots, in addition to the required dedicated visual observer, Ocean Wind must monitor the transit corridor in real-time with PAM prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kts or less for 12 hours following the detection. Each subsequent detection shall trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 12 hours;

(x) All underway vessels (*e.g.,* transiting, surveying) operating at any speed must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard) located at an appropriate vantage point for ensuring vessels are maintaining appropriate separation distances. Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this subpart. Visual observers may be third-party observers (*i.e.,* NMFS-approved PSOs) or crew members. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities. Confirmation of the observers' training and understanding of the Incidental Take Authorization (ITA) requirements must be documented on a training course log sheet and reported to NMFS;

(xi) All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kts or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take the vessel strike avoidance measures described in this paragraph (b)(2)(xi);

(xii) All vessels must maintain a minimum separation distance of 100 m from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 100 m;

(xiii) All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m;

(xiv) When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.,* any situation where the vessel is navigationally constrained);

(xv) All vessels underway must not divert or alter course to approach any marine mammal. Any vessel underway must avoid speed over 10 kts or abrupt changes in course direction until the animal is out of an on a path away from the separation distances; and

(xiv) For in-water construction heavy machinery activities other than impact or vibratory pile driving, if a marine mammal is on a path towards or comes within 10 m of equipment, Ocean Wind must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment.

(c) *Fisheries monitoring surveys*—(1) *Training.* (i) All crew undertaking the fishery survey activities must receive protected species identification training prior to activities occurring.

(ii) [Reserved]

(2) *During vessel use.* (i) Marine mammal monitoring must occur prior to, during, and after haul-back, and gear must not be deployed if a marine mammal is observed in the area;

(ii) Trawl operations must only start after 15 minutes of no marine mammal sightings within 1 nm of the sampling station; and

(iii) During daytime sampling for the research trawl surveys, Ocean Wind must maintain visual monitoring efforts during the entire period of time that trawl gear is in the water from deployment to retrieval. If a marine mammal is sighted before the gear is removed from the water, the vessel must slow its speed and steer away from the observed animal(s).

(3) *Gear-specific best management practices (BMPs).* (i) Baited remote underwater video (BRUV) sampling and chevron trap usage, for example, would utilize specific mitigation measures to reduce impacts to marine mammals. These specifically include the breaking strength of all lines being less than 1,700 pounds (771 kg), limited soak durations of 90 minutes or less, no gear being left without a vessel nearby, and a delayed deployment of gear if a marine mammal is sighted nearby;

(ii) The permit number will be written clearly on buoy and any lines that go missing will be reported to NOAA Fisheries' Greater Atlantic Regional Fisheries Office (GARFO) Protected Resources Division as soon as possible;

(iii) If marine mammals are sighed near the proposed sampling location, chevron traps and/or BRUVs will not be deployed;

(iv) If a marine mammal is determined to be at risk of interaction with the deployed gear, all gear will be immediately removed;

(v) Marine mammal monitoring would occur during daylight hours and begin prior to the deployment of any gear (*e.g.,* trawls, longlines) and continue until all gear has been retrieved; and

(vi) If marine mammals are sighted in the vicinity within 15 minutes prior to gear deployment and it is determined the risks of interaction are present regarding the research gear, the sampling station will either move to another location or suspend activities until there are no marine mammal sightings for 15 minutes within 1 nm.

(d) *Wind turbine generator (WTG) and offshore substation (OSS) foundation installation*—(1) *Seasonal and daily restrictions.* (i) Foundation impact pile driving activities may not occur January 1 through April 30;

(ii) No more than two foundation monopiles may be installed per day;

(iii) Ocean Wind must not initiate pile driving later than 1.5 hours after civil sunset or 1 hour before civil sunrise unless Ocean Wind submits an Alternative Monitoring Plan to NMFS for approval that proves the efficacy of their night vision devices; and

(iv) Monopiles must be no larger than 11-m in diameter, representing the larger end of the tapered 8/11-m monopile design. If jacket foundations are used for OSSs, pin piles must be no larger than 2.44-m in diameter. For all monopiles and pin piles, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,000 kJ.

(2) *Noise abatement systems.* (i) Ocean Wind must deploy dual noise abatement systems that are capable of achieving, at a minimum, 10 dB of sound attenuation, during all impact pile driving of foundation piles.

(A) A single big bubble curtain (BBC) must not be used unless paired with another noise attenuation device; and

(B) A double big bubble curtain (dBBC) may be used without being paired with another noise attenuation device.

(ii) The bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 $m^3/(min*m)$. The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must make appropriate adjustments to the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved.

(iii) The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact.

(iv) No parts of the ring or other objects may prevent full seafloor contact.

(v) Construction contractors must train personnel in the proper balancing of airflow to the ring. Construction contractors must submit an inspection/performance report for approval by Ocean Wind within 72 hours following the performance test. Corrections to the bubble ring(s) to meet the performance standards must occur prior to impact pile driving of monopiles. If Ocean Wind uses a noise mitigation device in addition to the BBC, Ocean Wind must maintain similar quality control measures as described here.

(3) *Sound field verification.* (i) Ocean Wind must perform sound field verification (SFV) during all impact pile driving of the first three monopiles and a full jacket foundation (16 total pin piles) and must empirically determine source levels (peak and cumulative sound exposure level), the ranges to the isopleths corresponding to the Level A harassment (permanent threshold shifts (PTS)) and Level B harassment (temporary threshold shifts (TTS)) thresholds, and estimated transmission loss coefficients.

(ii) If a subsequent monopile and pin pile installation and location is selected that was not represented by previous three locations (*i.e.,* substrate composition, water depth), SFV must be conducted.

(iii) Ocean Wind must measure received levels at a standard distance of 750 m from the monopiles and pin piles.

(iv) If SFV measurements on any of the first three piles indicate that the ranges to Level A harassment and Level B harassment isopleths are larger than those modeled, assuming 10-dB attenuation, Ocean Wind must modify and/or apply additional noise attenuation measures (*e.g.,* improve efficiency of bubble curtain(s), modify the piling schedule to reduce the source sound, install an additional noise attenuation device) before the second pile is installed. Until SFV confirms the ranges to Level A harassment and Level B harassment isopleths are less than or equal to those modeled, assuming 10-dB attenuation, the shutdown and clearance zones must be expanded to match the ranges to the Level A harassment and Level B harassment isopleths based on the SFV measurements. If the application/use of additional noise attenuation measures still does not achieve ranges less than or equal to those modeled, assuming 10-dB attenuation, and no other actions can further reduce sound levels, Ocean Wind must expand the clearance and shutdown zones according to those identified through SFV, in consultation with NMFS.

(v) If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Ocean Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles and pin piles. For a modification request to be considered by NMFS, Ocean Wind must have conducted SFV on three or more monopiles and at least one entire jacket foundation (16 pin piles) to verify that zone sizes are consistently smaller than predicted by modeling (assuming 10 dB attenuation).

(vi) Ocean Wind must submit a SFV Plan at least 180 days prior to the planned start of impact pile driving. The plan would describe how Ocean Wind would ensure that the first three monopile and jacket foundation installation sites selected for SFV are representative of the rest of the monopile and pin pile installation. In the case that these sites are not determined to be representative of all other monopile and pin pile installation sites, Ocean Wind must include information on how additional sites would be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Ocean Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first three piles and pin pile installation for the first full jacket foundation (16 pin piles).

(4) *PSO and PAM use.* (i) Ocean Wind must have a minimum of four PSOs actively observing marine mammals before, during, and after (specific times described in this paragraph (d)(4)) the installation of foundation piles (monopiles and/or pin piles). At least four PSOs must be actively observing for marine mammals. At least two PSOs must be actively observing on the pile driving vessel while at least two PSOs must be actively observing on a secondary, PSO-dedicated vessel. At least one active PSO on each platform must have a minimum of 90 days at-sea experience working in those roles in offshore environments with no more than 18 months elapsed since the conclusion of the at-sea experience. Concurrently, at least one acoustic PSO (*i.e.,* PAM operator) must be actively monitoring for marine mammals before, during and after impact pile driving.

(ii) All visual PSOs and PAM operators used for the Ocean Wind project must meet the requirements and qualifications described in § 217.265(a), (b), and (c), respectively, and as applicable to the specified activity.

(5) *Clearance and shutdown zones.* (i) Ocean Wind must establish and implement clearance and shutdown zones (all distances to the perimeter are the radii from the center of the pile being driven) as described in the LOA for all WTG and OSS foundation installation.

(ii) Ocean Wind must use visual PSOs and PAM operators to monitor the area around each foundation pile before, during and after pile driving. PSOs must visually monitor clearance zones for marine mammals for a minimum of 60 minutes prior to commencing pile driving. Acoustic PSOs (at least one PAM operator) must review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes immediately prior to starting a soft-start of pile driving.

(iii) PSOs must be able to visually clear (*i.e.,* confirm no marine mammals are present) an area that extends around the pile being driven as described in the LOA. The entire minimum visibility zone must be visible (*i.e.,* not obscured by dark, rain, fog, *etc.*) for a full 30 minutes immediately prior to commencing impact pile driving (based on season; summer and winter minimum visibility zones). Clearance zones extending beyond this minimum visibility zone may be cleared using both visual and acoustic methods.

(iv) If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and must not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species).

(v) The clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred during the 60-minute monitoring period. Any large whale sighting by a PSO or detected by a PAM operator that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale.

(vi) If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after impact pile driving has begun, the

PSO must call for a temporary cessation of impact pile driving.

(vii) Ocean Wind must immediately cease pile driving upon orders of the PSO unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. In this situation, reduced hammer energy must be implemented instead, as determined to be practicable.

(viii) Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time the lowest hammer energy must be used to maintain stability.

(ix) If impact pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection.

(x) Upon re-starting pile driving, soft start protocols must be followed.

(6) *Soft start.* (i) Ocean Wind must utilize a soft start protocol for impact pile driving of monopiles by performing 4–6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes.

(ii) Soft start must occur at the beginning of monopile installation and at any time following a cessation of impact pile driving of 30 minutes or longer.

(iii) If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving would be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other species.

(e) *Cofferdam installation*—(1) *Seasonal and daily restrictions.* (i) Ocean Wind must only conduct cofferdam installation/removal from October through March, although some removal shall also be allowed to occur in April or May.

(ii) Ocean Wind must conduct vibratory pile driving associated with cofferdam installation and removal during daylight hours only.

(2) *PSO use.* (i) All visual PSOs used for the Ocean Wind project must meet the requirements and qualifications described in § 217.265(a) and (b), as applicable to the specified activity.

(ii) Ocean Wind must have a minimum of two PSOs on active duty during any installation and removal of the temporary cofferdams. These PSOs would always be located at the best vantage point(s) on the vibratory pile driving platform or secondary platform in the immediate vicinity of the vibratory pile driving platform, in order to ensure that appropriate visual coverage is available of the entire visual clearance zone and as much of the Level B harassment zone, as possible.

(3) *Clearance and shutdown zones.* (i) Ocean Wind must establish and implement clearance and shutdown zones as described in the LOA.

(ii) Prior to the start of vibratory pile driving activities, at least two PSOs must monitor the clearance zone for 30 minutes, continue monitoring during pile driving and for 30 minutes post pile driving.

(iii) If a marine mammal is observed entering or is observed within the clearance zones, piling must not commence until the animal has exited the zone or a specific amount of time has elapsed since the last sighting. The specific amount of time is 30 minutes for large whales and 15 minutes for dolphins, porpoises, and pinnipeds.

(iv) If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after vibratory pile driving has begun, the PSO must call for a temporary cessation of vibratory pile driving.

(v) Ocean Wind must immediately cease pile driving upon orders of the PSO unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability.

(vi) Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species.

(f) *UXO/MEC detonation(s)*—(1) *General.* (i) Ocean Wind shall only detonate a maximum of 10 UXO/MECs, of varying sizes, during the entire effective period of this subpart and LOA.

(ii) Upon encountering a UXO/MEC of concern, Ocean Wind may only resort to high-order removal (*i.e.,* detonation) after all other means by which to remove the UXO/MEC have been exhausted. Ocean Wind must not detonate a UXO/MEC if another means of removal is practicable.

(iii) Ocean Wind must utilize a noise abatement system (*e.g.,* bubble curtain or similar noise abatement device) around all UXO/MEC detonations and operate that system in a manner that achieves maximum noise attenuation levels practicable.

(2) *Seasonal and daily restrictions.* (i) Ocean Wind must not detonate UXOs/MECs from November 1st through April 31st, annually.

(ii) Ocean Wind must only detonate UXO/MECs during daylight hours.

(3) *PSO and PAM use.* (i) All visual PSOs and PAM operators used for the Ocean Wind project must meet the requirements and qualifications described in § 217.265(a), (b), and (c), respectively, and as applicable to the specified activity.

(ii) Ocean Wind must use at least six visual PSOs and one acoustic PSO to clear the area prior to detonation. These PSOs would be located on at least two dedicated PSO vessels or, if the largest clearance zone is greater than 5 km, one dedicated PSO vessel and one aerial platform (*i.e.,* airplane).

(4) *Clearance zones.* (i) Ocean Wind must establish and implement clearance zones using both visual and acoustic monitoring, as described in the LOA.

(ii) Clearance zones must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes prior to detonation. PAM must also be conducted for at least 60 minutes and the zone must be acoustically cleared during this time.

(iii) If a marine mammal is observed entering or within the clearance zone prior to denotation, the activity must be delayed. Detonation may only commence if all marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales (including the North Atlantic right whale) or 15 minutes have elapsed without any redetections of delphinids, harbor porpoises, or seals.

(5) *Sound field verification.* (i) During each UXO/MEC detonation, Ocean Wind must empirically determine source levels (peak and cumulative sound exposure level), the ranges to the isopleths corresponding to the Level A harassment and Level B harassment

thresholds, and estimated transmission loss coefficient(s).

(ii) If SFV measurements on any of the detonations indicate that the ranges to Level A harassment and Level B harassment thresholds are larger than those modeled, assuming 10-dB attenuation, Ocean Wind must modify the ranges, with approval from NMFS, and/or apply additional noise attenuation measures (*e.g.,* improve efficiency of bubble curtain(s), install an additional noise attenuation device) before the next detonation event.

(g) *HRG surveys*—(1) *General.* (i) All personnel with responsibilities for marine mammal monitoring must participate in joint, onboard briefings that would be led by the vessel operator and the Lead PSO, prior to the beginning of survey activities. The briefing must be repeated whenever new relevant personnel (*e.g.,* new PSOs, acoustic source operators, relevant crew) join the survey operation before work commences.

(ii) Ocean Wind must deactivate acoustic sources during periods where no data is being collected, except as determined to be necessary for testing. Any unnecessary use of the acoustic source(s) must be avoided.

(iii) Ocean Wind must instruct all vessel personnel regarding the authority of the marine mammal monitoring team(s). For example, the vessel operator(s) would be required to immediately comply with any call for a shutdown by the Lead PSO. Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred.

(iv) Any large whale sighted by a PSO within 1 km of the boomer, sparker, or Compressed High-Intensity Radiated Pulse (CHIRP) that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale.

(2) *PSO use.* (i) Ocean Wind must use at least one PSO during daylight hours and two PSOs during nighttime operations, per vessel. Any PSO shall have the authority to call for a delay or shutdown of the survey activities.

(ii) PSOs must establish and monitor the appropriate clearance and shutdown zones (*i.e.,* radial distances from the acoustic source in-use and not from the vessel).

(iii) PSOs must begin visually monitoring 30 minutes prior to the initiation of the specified acoustic source (*i.e.,* ramp-up, if applicable), through 30 minutes after the use of the specified acoustic source has ceased.

(3) *Ramp-up.* (i) Any ramp-up activities of boomers, sparkers, and CHIRPs must only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using a specified acoustic source.

(ii) Prior to starting the survey and after receiving confirmation from the PSOs that the clearance zone is clear of any marine mammals, Ocean Wind must ramp-up sources to half power for 5 minutes and then proceed to full power, unless the source operates on a binary on/off switch in which case ramp-up is not feasible. Ramp-up activities would be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up would only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until additional time has elapsed with no further sighting. The specific time periods are 15 minutes for small odontocetes and seals, and 30 minutes for all other species.

(4) *Clearance and shutdown zones.* (i) Ocean Wind must establish and implement clearance zones as described in the LOA.

(ii) Ocean Wind must implement a 30-minute clearance period of the clearance zones immediately prior to the commencing of the survey or when there is more than a 30 minute break in survey activities and PSOs are not actively monitoring.

(iii) If a marine mammal is observed within a clearance zone during the clearance period, ramp-up would not be allowed to begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

(iv) In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (*i.e.,* no delay is required) despite periods of inclement weather and/or loss of daylight.

(v) Once the survey has commenced, Ocean Wind must shut down boomers, sparkers, and CHIRPs if a marine mammal enters a respective shutdown zone.

(vi) In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.,* no shutdown is required) so long as no marine mammals have been detected.

(vii) The use of boomers, sparkers, and CHIRPS would not be allowed to commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting.

(viii) Ocean Wind must immediately shutdown any boomer, sparker, or CHIRP acoustic source if a marine mammal is sighted entering or within its respective shutdown zones (500 m for North Atlantic right whale; 100 m for all other marine mammals, except for those specified here). The shutdown requirement does not apply to small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus,* and *Tursiops.* If there is uncertainty regarding the identification of a marine mammal species (*i.e.,* whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified here is detected in the shutdown zone.

(ix) If a boomer, sparker, or CHIRP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if:

(A) PSOs have maintained constant observation; and

(B) No additional detections of any marine mammal occurred within the respective shutdown zones.

(x) If a boomer, sparker, or CHIRP was shut down for a period longer than 30 minutes, then all clearance and ramp-up procedures must be initiated.

§ 217.265 Requirements for monitoring and reporting.

(a) *PSO qualifications.* (1) Ocean Wind must employ qualified, trained visual and acoustic PSOs to conduct marine mammal monitoring during activities associated with construction. PSO requirements are as follows:

(i) Ocean Wind must use independent, dedicated, qualified PSOs, meaning that the PSOs must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements;

(ii) All PSOs must be approved by NMFS. Ocean Wind must submit PSO resumes for NMFS' review and approval at least 60 days prior to commencement of in-water construction activities requiring PSOs. Resumes must include dates of training and any prior NMFS approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS shall be allowed 3 weeks to approve PSOs from the time that the necessary information is received by NMFS, after which PSOs meeting the minimum requirements must automatically be considered approved;

(iii) PSOs must have visual acuity in both eyes (with correction of vision being permissible) sufficient enough to discern moving towards the water's surface with the ability to estimate the target size and distance (binocular use is allowable);

(iv) All PSOs must be trained in marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations;

(v) PSOs must have sufficient writing skills to document all observations, including but not limited to:

(A) The number and species of marine mammals observed;

(B) The dates and times of when in-water construction activities were conducted;

(C) The dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone; and

(D) Marine mammal behavior;

(vi) All PSOs must be able to communicate orally, by radio, or in-person with Ocean Wind project personnel;

(vii) PSOs must have sufficient training, orientation, or experience with construction operations to provide for their own personal safety during observations;

(A) All PSOs must complete a Permits and Environmental Compliance Plan training and a 2-day refresher session that will be held with the PSO provider and Project compliance representative(s) prior to the start of construction activities.

(B) [Reserved]

(viii) At least one PSO must have prior experience working as an observer. Other PSOs may substitute education (*i.e.,* degree in biological science or related field) or training for experience;

(ix) One PSO for each activity (*i.e.,* foundation installation, cofferdam installation, HRG surveys, UXO/MEC detonation) must be designated as the ''Lead PSO.'' The Lead PSO must demonstrate prior experience working as a PSO in offshore environments, specifically with prior experience observing mysticetes, odontocetes, and pinnipeds in the Northwestern Atlantic Ocean;

(x) At a minimum, two of the PSOs located on observation platforms (either vessel-based or aerial-based) must have a minimum of 90 days of at-sea experience and must have had this at-sea experience within the last 18 months. Any new and/or inexperienced PSOs would be paired with an experienced PSO;

(xi) PSOs must not exceed 4 consecutive watch hours, must have a minimum break of 2 hours, and must not exceed a total watch schedule of more than 12 hours within any 24-hour period;

(xii) PSOs must monitor all clearance and shutdown zones prior to, during, and following impact pile driving, vibratory pile driving, UXO/MEC detonations, and during HRG surveys that use boomers, sparkers, and CHIRPs with specific monitoring durations described in paragraph (b)(1)(ii) of this section. PSOs must also monitor the Level B harassment zones and document any marine mammals observed within these zones, to the extent practicable;

(xiii) PSOs must be located on the best available vantage point(s) on the primary vessel(s) (*i.e.,* pile driving vessel, UXO/MEC vessel, HRG survey vessel) and on other dedicated PSO vessels (*e.g.,* additional UXO/MEC vessels) or aerial platforms, as applicable and necessary, to allow them appropriate coverage of the entire visual shutdown zone(s), clearance zone(s), and as much of the Level B harassment zone as possible. These vantage points must maintain a safe work environment; and

(xiv) Acoustic PSOs are required to complete specialized training for operating PAM systems and must demonstrate familiarity with the PAM system on which they must be working. PSOs may act as both acoustic and visual observers (but not simultaneously), so long as they demonstrate that their training and experience are sufficient to perform each task.

(A) All PAM operators must complete a Permits and Environmental Compliance Plan training and a 2-day refresher session that will be held with the PSO/PAM operator provider and Project compliance representative(s) prior to the start of construction activities.

(B) [Reserved]

(b) *PSO requirements*—(1) *General.* (i) All PSOs must be located at the best vantage point(s) primary vessel and any dedicated PSO vessels in order to ensure 360° visual coverage of the entire clearance and shutdown zones around the vessels, and as much of the Level B harassment zone as possible. During UXO/MEC detonation events, monitoring from an aerial platform would also be required.

(ii) During all observation periods, PSOs must use high magnification (25×) binoculars, standard handheld (7×) binoculars, and the naked eye to search continuously for marine mammals. During impact pile driving and UXO/MEC detonation events, at least one PSO on the primary pile driving or UXO/MEC vessel must be equipped with Big Eye binoculars (*e.g.,* 25 × 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality. These must be pedestal mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation and PSO safety.

(iii) PSOs must not exceed four consecutive watch hours on duty at any time, must have a 2-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period.

(2) *WTG and OSS foundation installation.* (i) At least four PSOs must be actively observing marine mammals before, during, and after installation of foundation piles (monopiles and/or pin piles). At least two PSOs must be stationed and observing on the pile driving vessel and at least two PSOs must be stationed on a secondary, PSO-dedicated vessel. Concurrently, at least one acoustic PSO (*i.e.,* PAM operator) must be actively monitoring for marine mammals with PAM before, during and after impact pile driving.

(ii) If PSOs cannot visually monitor the minimum visibility zone at all times using the equipment described in paragraph (b)(1)(ii) of this section or approved alternative equipment, impact pile driving operations must not commence or must shutdown if they are currently active.

(iii) All PSOs, including PAM operators, must begin monitoring 60 minutes prior to pile driving, during, and for 30 minutes after an activity. The impact pile driving of both monopiles and/or pin piles must only commence when the minimum visibility zone is fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of impact pile driving.

(iv) For North Atlantic right whales, any visual or acoustic detection must trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale species, it must be treated as if it were a North Atlantic right whale.

(v) Following a shutdown, monopile and/or pin pile installation must not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes.

(3) *Cofferdam installation and removal.* (i) At least two PSOs must be on active duty during all activities related to the installation and removal of cofferdams.

(ii) These PSOs must be located at appropriate vantage points on the vibratory pile driving platform or secondary platform in the immediate vicinity of the vibratory pile driving platform.

(iii) PSOs must ensure that there is appropriate visual coverage for the entire clearance zone and as much of the Level B harassment zone as possible.

(iv) PSOs must monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles (and casing pipe, if installed), and for 30 minutes after all vibratory pile driving activities have ceased. Sheet pile or casing pipe installation shall only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving.

(4) *UXO/MEC detonations.* (i) At least six PSOs must be on active duty prior to, during, and after UXO/MEC detonations and must be located on at least two dedicated PSO vessels. Two PSOs must also be on the airplane during aerial surveys and must monitor for marine mammals before, during, and after UXO/MEC detonation events.

(ii) All PSOs, including PAM operators, must begin monitoring 60 minutes prior to UXO/MEC detonation, during, and for 30 minutes after an activity.

(iii) For detonation areas larger than 2 km, Ocean Wind must use a secondary vessel to monitor. For any additional vessels determined to be necessary, two PSOs must be used and located at the appropriate vantage point on the vessel. These additional PSOs would maintain watch during the same time period as the PSOs on the primary monitoring vessel. Prior to, during, and after any detonation occurring, Ocean Wind must ensure that these clearance zones are fully (100 percent) monitored.

(5) *HRG surveys.* (i) Between four and six PSOs would be present on every 24-hour survey vessel and two to three PSOs would be present on every 12-hour survey vessel. At least one PSO must be on active duty during HRG surveys conducted during daylight and at least two PSOs must be on activity duty during HRG surveys conducted at night.

(ii) During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* infrared/thermal camera) to monitor the clearance and shutdown zones.

(iii) PSOs on HRG vessels must begin monitoring 30 minutes prior to activating boomers, sparkers, or CHIRPs, during, and 30 minutes after use of those sources has ceased.

(iv) Any observations of marine mammals must be communicated to PSOs on all nearby survey vessels during concurrent HRG surveys.

(v) During daylight hours when survey equipment is not operating, Ocean Wind must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports.

(c) *PAM operator requirements*—(1) *General.* (i) PAM operators must have completed specialized training for operating PAM systems prior to the start of monitoring activities, including identification of species-specific mysticete vocalizations.

(ii) During use of any real-time PAM system, at least one PAM operator must be designated to monitor each system by viewing data or data products that would be streamed in real-time or in near real-time to a computer workstation and monitor.

(iii) PAM operators may be located on a vessel or remotely on-shore but must have the appropriate equipment available wherever they are stationed.

(iv) Visual PSOs must remain in contact with the PAM operator currently on duty regarding any animal detection that would be approaching or found within the applicable zones no matter where the PAM operator is stationed (*i.e.,* onshore or on a vessel).

(v) The PAM operator must inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.,* Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures.

(vi) PAM operators must be on watch for a maximum of 4 consecutive hours, followed by a break of at least 2 hours between watches.

(vii) A Passive Acoustic Monitoring Plan must be submitted to NMFS for review and approval at least 180 days prior to the planned start of monopile and/or pin pile installation.

(2) *WTG and OSS foundation installation.* (i) Ocean Wind must use a minimum of one PAM operator before, during, and after impact pile driving activities commence. The PAM operator must assist visual PSOs in ensuring full coverage of the clearance and shutdown zones.

(ii) PAM operators must assist the visual PSOs in monitoring by beginning PAM activities 60 minutes prior to any impact pile driving, during, and after for 30 minutes for the appropriate distance (based on season). The entire minimum visibility zone must be clear for at least 30 minutes with no marine mammal detections prior to the start of impact pile driving.

(iii) Any acoustic monitoring during low visibility conditions during the day would complement visual monitoring efforts and would cover an area of at least the Level B harassment zone around each monopile or pin pile foundation.

(iv) Any visual or acoustic detection must trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale species, it must be treated as if it were a North Atlantic right whale. Following a shutdown, monopile and/or pin pile installation shall not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes.

(3) *UXO/MEC detonation(s).* (i) Ocean Wind must use a minimum of one PAM operator on one of two dedicated PSO vessels for monitoring during daylight UXO/MEC detonation(s).

(ii) PAM must be conducted for at least 60 minutes prior to detonation, during, and for 30 minutes after detonation and the zone must be acoustically clear during this entire duration.

(iii) The PAM operator must monitor to and past the clearance zone for large whales.

(d) *Data collection and reporting.* (1) Prior to initiation of project activities, Ocean Wind must demonstrate in a report submitted to NMFS (at *itp.potlock@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that all required training for Ocean Wind personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed.

(2) Ocean Wind must use a standardized reporting system during the effective period of the regulations in this subpart and LOA. All data collected related to the Ocean Wind 1 project must be recorded using industry-standard software (*e.g.,* Mysticetus or a similar software) that is installed on field laptops and/or tablets. Ocean Wind must collect the following information during activities requiring PSOs:

(i) Date and time that monitored activity begins or ends;

(ii) Construction activities occurring during each observation period;

(iii) Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(iv) PSO who sighted the animal;

(v) Time of sighting;

(vi) Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility);

(vii) Water conditions (*e.g.,* sea state, tide state, water depth);

(viii) All marine mammal sightings, regardless of distance from the construction activity;

(ix) Species (or lowest possible taxonomic level possible)

(x) Pace of the animal(s);

(xi) Estimated number of animals (minimum/maximum/high/low/best);

(xii) Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*);

(xiii) Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

(xiv) Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity;

(xv) Animal's closest distance and bearing from the pile being driven, UXO/MEC, or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zones;

(xvi) Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, UXO/MEC detonation, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft start for pile driving, active pile driving, post-UXO/MEC detonation, *etc.*);

(xvii) Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action; and

(xviii) Other human activity in the area.

(3) For all marine mammal sightings by PSOs, the following information must also be collected and reported to NMFS:

(i) Identification of the animal(s) (*i.e.,* genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;

(ii) Pace of the animal(s);

(iii) Estimated number of animals (high/low/best);

(iv) Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*);

(v) Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

(vi) Description of any observations of marine mammal behavior (*e.g.,* observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity (*e.g.,* no response or changes in behavioral state such as ceasing feeding, changing direction, or breaching);

(vii) Animal's closest distance from the pile being driven or specified HRG equipment and estimated time spent within the Level A harassment and/or Level B harassment zones;

(viii) Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, construction survey), use of any noise attenuation device, and specific phase of activity (*e.g.,* ramp-up HRG equipment, HRG acoustic source on/off, soft start for pile driving, active pile driving, *etc.*);

(ix) Distance and bearing to each marine mammal observed;

(x) Description of any mitigation-related actions implemented, or mitigation-relation actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action;

(xi) Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(xii) PSO who sighted the animal;

(xiii) Time of sighting;

(xiv) Location of sighting;

(xv) Water depth;

(xvi) Sea state and weather; and

(xvii) Marine mammal occurrence within relevant Level A harassment or Level B harassment zones.

(4) For all real-time acoustic detections of marine mammals, the following must be recorded and included in weekly, monthly, annual, and final reports:

(i) Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name;

(ii) Bottom depth and depth of recording unit (in meters);

(iii) Recorder (model & manufacturer) and platform type (*i.e.,* bottom-mounted, electric glider, *etc.*), and instrument ID of the hydrophone and recording platform (if applicable);

(iv) Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. *i.e.,* EST time zone is UTC–5);

(v) Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ);

(vi) Deployment/retrieval dates and times (in ISO 8601 format);

(vii) Recording schedule (must be continuous);

(viii) Hydrophone and recorder sensitivity (in dB *re. 1* µ*Pa*);

(ix) Calibration curve for each recorder;

(x) Bandwidth/sampling rate (in Hz);

(xi) Sample bit-rate of recordings; and,

(xii) Detection range of equipment for relevant frequency bands (in meters).

(5) For each detection, the following information must be noted:

(i) Species identification (if possible);

(ii) Call type and number of calls (if known);

(iii) Temporal aspects of vocalization (date, time, duration, *etc.,* date times in ISO 8601 format);

(iv) Confidence of detection (detected, or possibly detected);

(v) Comparison with any concurrent visual sightings;

(vi) Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities;

(vii) Location of recorder and construction activities at time of call;

(viii) Name and version of detection or sound analysis software used, with protocol reference;

(ix) Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and,

(x) Name of PAM operator(s) on duty.

(6) Ocean Wind must compile and submit weekly PSO and PAM reports to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that document the daily start and stop of all pile driving, HRG survey, or UXO/MEC detonation activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals, any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise attenuation system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday–Saturday) and must include the information required under this section.

(7) Ocean Wind must compile and submit monthly reports to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The report should note the location and date of any turbines that become operational.

(8) Ocean Wind must submit an annual report to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) no later than 90 days following the end of a given calendar year. Ocean Wind must provide a final report within 30 days following resolution of comments on the draft report. The report must detail the following information:

(A) The total number of marine mammals of each species/stock detected and how many were within the designated Level A harassment and Level B harassment zones with comparison to authorizes take of marine mammals for the associated activity type;

(B) Marine mammal detections and behavioral observations before, during, and after each activity;

(C) What mitigation measures were implemented (*i.e.,* number of shutdowns or clearance zone delays, *etc.*) or, if no mitigative actions was taken, why not;

(D) Operational details (*i.e.,* days of impact and vibratory pile driving, days/amount of HRG survey effort, total number and charge weights related to UXO/MEC detonations, etc.);

(E) Sound field verification results;

(F) Any PAM systems used;

(G) The results, effectiveness, and which noise abatement systems were used during relevant activities (*i.e.,* impact pile driving, UXO/MEC detonation);

(H) Summarized information related to situational reporting (see paragraph (d)(12) of this section); and

(I) Any other important information relevant to the Ocean Wind 1 project, including additional information that may be identified through the adaptive management process.

(ii) The final annual report must be prepared and submitted within 30 calendar days following the receipt of any comments from NMFS on the draft report. If no comments are received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report must be considered final.

(9) Ocean Wind must submit its draft final report(s) to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) on all visual and acoustic monitoring conducted under the LOA within 90 calendar days of the completion of activities occurring under the LOA. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of NMFS' receipt of the draft report, the report shall be considered final.

(10) By 90 days after the expiration of the rule, Ocean Wind must submit a final report to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that summarizes all of the data contained within the annual reports. A final 5-year report would be prepared and submitted within 60 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final.

(11)(i) Ocean Wind must provide the initial results of the SFV measurements to NMFS in an interim report after each monopile and jacket foundation installation for the first three monopiles piles, completion of installing one jacket foundation, and for each UXO/MEC detonation as soon as they are available, but no later than 48 hours after each installation. Ocean Wind must also provide interim reports on any subsequent SFV on foundation piles within 48 hours. The interim report must include hammer energies used during pile driving or UXO/MEC weight (including donor charge weight), peak sound pressure level (SPL_{pk}) and median, mean, maximum, and minimum root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}) and single strike sound exposure level (SEL_{ss}); and

(ii) The final results of SFV of monopile installations must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of the three monopiles and jacket foundations and UXO/MEC data to date. The final report must include, at minimum, the following:

(A) Peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), single strike sound exposure level (SEL_{ss}), integration time for SPL_{rms}, SEL_{ss} spectrum, and 24-hour cumulative SEL extrapolated from measurements at specified distances (*e.g.,* 750 m). All these levels must be reported in the form of median, mean, maximum, and minimum. The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported;

(B) The sound levels reported must be in median and linear average (*i.e.,* average in linear space), and in dB;

(C) A description of depth and sediment type, as documented in the Construction and Operation Plan, at the recording and pile driving locations;

(D) Hammer energies required for pile installation and the number of strikes per pile;

(E) Hydrophone equipment and methods (*i.e.,* recording device, bandwidth/sampling rate, distance from the pile where recordings were made; depth of recording device(s));

(F) Description of the SFV PAM hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information;

(G) Description of UXO/MEC, weight, including donor charge weight, and why detonation was necessary;

(H) Local environmental conditions, such as wind speed, transmission loss data collected on-site (or the sound velocity profile), baseline pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern);

(I) Spatial configuration of the noise attenuation device(s) relative to the pile;

(J) The extents of the Level A harassment and Level B harassment zones; and

(K) A description of the noise attenuation devices and operational parameters (*e.g.,* bubble flow rate, distance deployed from the pile, *etc.*) and any action taken to adjust noise attenuation devices.

(12) Specific situations encountered during the development of Ocean Wind 1 shall require immediate reporting to be undertaken. These situations and the relevant procedures are described in paragraphs (d)(12)(i) through (v) of this section.

(i) If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any project vessel, or during vessel transit, Ocean Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755–6622, through the WhaleAlert app (*http://www.whalealert/org/*), and to the U.S. Coast Guard via channel 16, as soon as feasible, but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed.

(ii) When an observation of a marine mammal occurs during vessel transit, the following information must be recorded:

(A) Time, date, and location;

(B) The vessel's activity, heading, and speed;

(C) Sea state, water depth, and visibility;

(D) Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal);

(E) Initial distance and bearing to marine mammal from vessel and closest point of approach; and

(F) Any avoidance measures taken in response to the marine mammal sighting.

(iii) If a North Atlantic right whale is detected via PAM, the date, time, location (*i.e.,* latitude and longitude of recorder) of the detection as well as the recording platform that had the detection must be reported to *nmfs.pacmdata@noaa.gov* as soon as feasible, but no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*).

(iv) In the event that the personnel involved in the activities defined in § 217.260(c) discover an injured or dead marine mammal, Ocean Wind must immediately report the observation to the NMFS Office of Protected Resources (OPR), the NMFS Greater Atlantic Stranding Coordinator for the New England/Mid-Atlantic area (866–755–6622), the NMFS RWSAS hotline, and the U.S. Coast Guard within 24 hours. If the injury or death was caused by a project activity, Ocean Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Ocean Wind may not resume their activities until notified by NMFS. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(B) Species identification (if known) or description of the animal(s) involved;

(C) Condition of the animal(s) (including carcass condition if the animal is dead);

(D) Observed behaviors of the animal(s), if alive;

(E) If available, photographs or video footage of the animal(s); and

(F) General circumstances under which the animal was discovered.

(v) In the event of a vessel strike of a marine mammal by any vessel associated with the Ocean Wind 1 Offshore Energy Facility, Ocean Wind must immediately report the strike incident to the NMFS Office of Protected Resources and the GARFO within and no later than 24 hours. The incident must also be immediately reported to NMFS OPR (301–427–8401). Ocean Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. If activities related to the Ocean Wind 1 project caused the injury or death of the animal, Ocean Wind must supply a vessel to assist with any salvage efforts, if requested by NMFS. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the incident;

(B) Species identification (if known) or description of the animal(s) involved;

(C) Vessel's speed leading up to and during the incident;

(D) Vessel's course/heading and what operations were being conducted (if applicable);

(E) Status of all sound sources in use;

(F) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

(G) Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

(H) Estimated size and length of animal that was struck;

(I) Description of the behavior of the marine mammal immediately preceding and following the strike;

(J) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

(K) Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and,

(L) To the extent practicable, photographs or video footage of the animal(s).

§ 217.266 Letter of Authorization.

(a) To incidentally take marine mammals pursuant to this subpart, Ocean Wind must apply for and obtain an LOA.

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of this subpart.

(c) If an LOA expires prior to the expiration date of this subpart, Ocean Wind may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, Ocean Wind must apply for and obtain a modification of the LOA as described in § 217.267.

(e) The LOA must set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact (*i.e.,* mitigation) on the species, its habitat, and on the availability of the species for subsistence uses; and

(3) Requirements for monitoring and reporting.

(f) Issuance of the LOA must be based on a determination that the level of taking must be consistent with the findings made for the total taking allowable under this subpart.

(g) Notice of issuance or denial of an LOA must be published in the **Federal Register** within 30 days of a determination.

§ 217.267 Modifications of Letter of Authorization.

(a) An LOA issued under §§ 217.262 and 217.266 for the activities identified in § 217.260(c) shall be modified upon request by the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for this subpart (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section); and

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under this subpart were implemented.

(b) For a LOA modification request by the applicant that includes changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that do not change the findings made for this subpart or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis of the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under §§ 217.262 and 217.266 for the activities identified in § 217.260(c) may be modified by NMFS under the following circumstances:

(1) *Adaptive management.* NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with Ocean Wind regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in this subpart.

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA:

(A) Results from Ocean Wind's monitoring from the previous year(s).

(B) Results from other marine mammals and/or sound research or studies.

(C) Any information that reveals marine mammals may have been taken in a manner, extent, or number not authorized by this subpart or subsequent LOA.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS shall publish a notice of proposed LOA in the **Federal Register** and solicit public comment.

(2) *Emergencies.* If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in the LOA issued pursuant to §§ 217.262 and 217.266, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within 30 days of the action.

§§ 217.268–217.269 [Reserved]

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