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Petition for Incidental Take Regulations and Letter of Authorization Issuance for the Construction and Operations of Vineyard Northeast

Submitted To:

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD

Submitted By:

Vineyard Northeast LLC

VINEYARD OFFSHORE

Prepared By:

LGL Ecological Research Associates, Inc.

November 18, 2024

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Submitted To

Jolie Harrison, Division Chief
Permits and Conservation Division, Office of Protected Resources
1315 East-West Highway, F/PR1 Room 13805
Silver Spring, MD 20910
email: PR.ITP.applications@noaa.gov

Submitted By

Vineyard Northeast LLC

Prepared by

LGL Ecological Research Associates, Inc.
4103 S. Texas Avenue, Suite 211
Bryan, TX 77802

November 2024

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1 Description of Specified Activity

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." The Lease Area lies within the southeastern portion of the Massachusetts Wind Energy Area (MA WEA) and, at its closest point, is approximately 46 kilometers (km; 29 miles [mi]) from Nantucket. Between the Lease Area and shore, offshore export cables will be installed that connect to onshore transmission systems in Massachusetts and Connecticut.

The purpose of Vineyard Northeast is to generate competitively priced clean, renewable electricity from the Lease Area by as early as 2030 to meet the demand expressed by Northeastern states and/or other offtake users to achieve their renewable energy and carbon emission reduction goals. Vineyard Northeast will help diversify the states' electricity supply, increase energy reliability, and reduce regional greenhouse gas emissions. Vineyard Northeast is also consistent with Presidential Executive Order 14008 (Tackling the Climate Crisis at Home and Abroad), dated January 27, 2021, which directs the Secretary of the Interior, in consultation with other federal agencies, to review siting and permitting processes to identify steps to double offshore wind energy production by 2030, as well as the policy of the United States (US) to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (see 43 U.S.C. 1332(3)).

Vineyard Northeast is defined in the Vineyard Northeast Construction and Operations Plan (COP) using a Project Design Envelope (PDE) approach (Vineyard Northeast 2024a). Given that offshore wind technologies are rapidly evolving, Vineyard Northeast is being developed and permitted using a PDE based on expected commercial and technological advancements. The PDE outlines a reasonable range of project design parameters (e.g., multiple foundation types) and installation techniques (e.g., use of various cable installation tools). The use of a PDE allows analysis of the maximum impacts that could occur from Vineyard Northeast based on the "maximum design scenario" for each resource while providing the Proponent with the flexibility to optimize Vineyard Northeast within the approved PDE during later stages of the development process.

Under the PDE, Vineyard Northeast will include 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. One to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. WTGs will be installed on either monopile (maximum diameter of 14 meters [m]; 46 feet [ft]) or piled jacket (maximum pin pile diameter of 4.25 m [14 ft] with three or four legs) foundations. ESP foundations are assumed to be piled jacket structures (maximum pin pile diameter of 4.25 m [14 ft] with up to 18 piles).[1] The WTGs and ESPs will be oriented in fixed east-to-west rows and north-to-south columns with 1 nautical mile (NM; 1.9 km [1.2 mi]) spacing between positions.

Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. Up to two high voltage direct current (HVDC) offshore export cable bundles may be installed within the Connecticut OECC. Up to two HVDC offshore export cable bundles

[1] The ESP(s) will be installed on monopiles (maximum diameter of 14 m [46 ft]) or piled jacket foundations; the use of piled jacket foundations is more likely. For the purpose of impact analyses, it was conservatively assumed that the ESP(s) will be installed on piled jacket foundations.

or up to three high voltage alternating current (HVAC) cables may be installed within the Massachusetts OECC. If HVAC offshore export cables are used, the Proponent may install a booster station along the Massachusetts OECC in the northwestern aliquot of Lease Area OCS-A 0534 (New England Wind 1), which would be aligned with the 1 x 1 NM (1.9 km [1.2 mi]) grid layout of the adjacent Vineyard Wind 1 project. The booster station foundation is assumed to be the same as the ESP foundation (i.e., a piled jacket structure with a maximum pin pile diameter of 4.25 m [14 ft] and up to 18 piles).[2] Figure 1 shows an overview of the locations of Vineyard Northeast elements.

The full buildout of Vineyard Northeast will be subdivided into Project 1 and Project 2 approximately evenly between the northeastern and southwestern halves of the Lease Area in terms of WTG and ESP foundation positions.

- Project 1 will be located in the northeastern portion of the Lease Area and will be comprised of up to 84 WTG foundations and two ESP/booster station foundations. Project 1 is expected to utilize the Connecticut OECC.
- Project 2 will be located in the southwestern portion of the Lease Area and will be comprised of up to 83 WTG foundations and two ESP/booster station foundations. Project 2 is expected to utilize the Massachusetts OECC.

There is a potential overlap area between the two projects consisting of 10 foundation positions that could be allotted to either Project 1 or Project 2. In order to assess potential take of marine mammals incidental to foundation installation while ensuring that adequate take was requested for each project, the maximum case was assumed for each project. That is, the exposure and take estimates for each of the two projects include installation of all foundations in the overlap area. However, if these foundations are installed for one project, then the actual take will be lower for the other project. Thus, the sum of the estimated take for the two projects is greater than the estimated take for the full buildout. The realistic full buildout case is used to develop the total take request for Vineyard Northeast so as not to request more take than necessary. Additional information is provided in Section 6.3.

For the purpose of analyzing potential take of marine mammals as a result of Vineyard Northeast construction and operations activities, the following Vineyard Northeast activities were included: WTG (monopile or jacket) and ESP/booster station (jacket) foundation installation, landfall site cofferdam installation/removal, high-resolution geophysical (HRG) surveys using sparkers, boomers, and non-parametric sub-bottom profilers (i.e., CHIRP), and potential unexploded ordnance (UXO) detonations. Other construction activities, including construction vessel activity, fisheries monitoring surveys, seabed preparation and scour protection placement, installation of transition pieces, WTGs, and ESP/booster station topsides, and offshore cable installation activities, were considered but deemed unlikely to result in marine mammal take. Descriptions of all offshore Vineyard Northeast elements and activities are provided in Section 1.1 below.

[2] Like the ESP(s), the booster station will be installed on a monopile (maximum diameter of 14 m [46 ft]) or piled jacket foundation. For the purpose of impact analyses, it was conservatively assumed that the booster station will be installed on a piled jacket foundation.

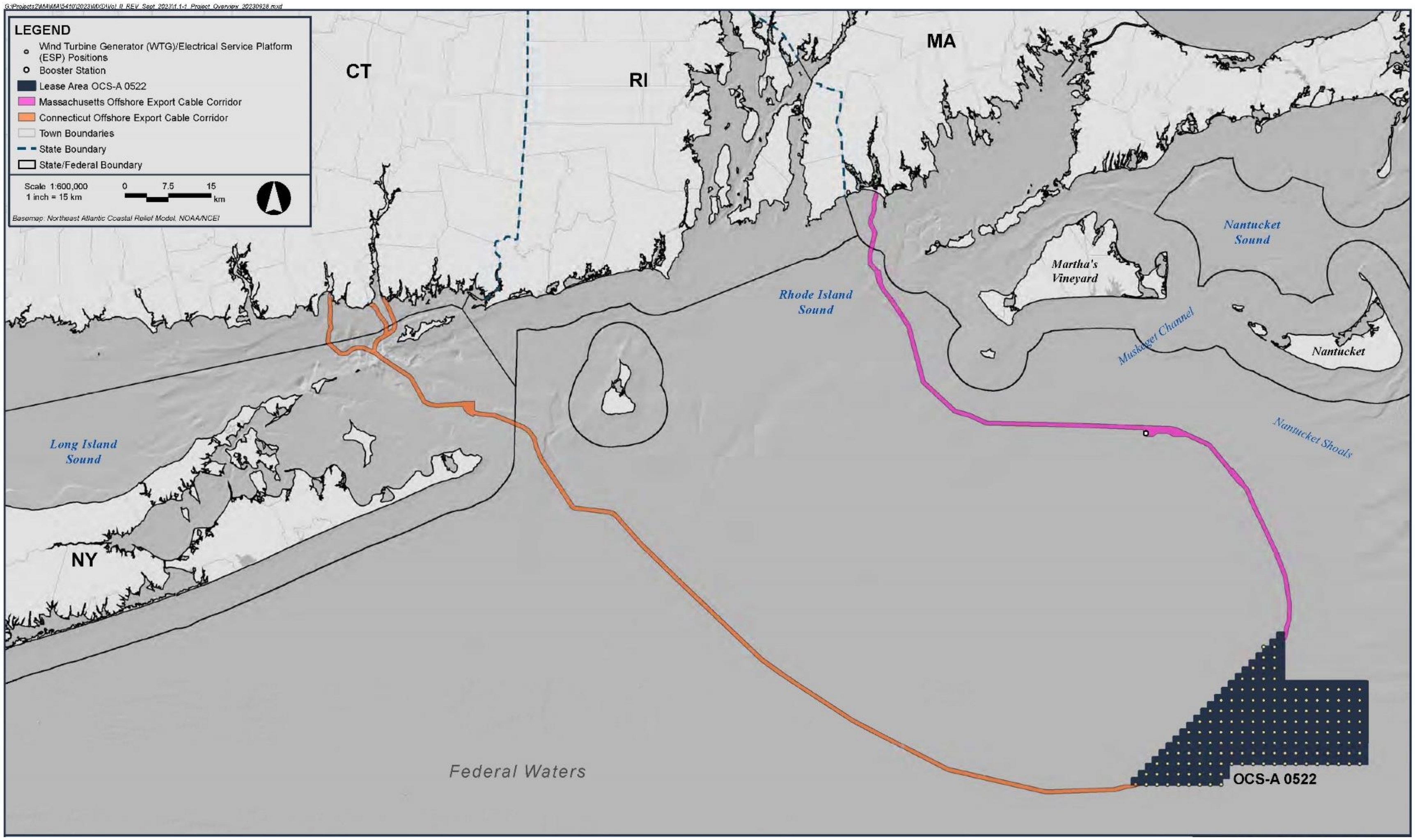

Figure 1. Overview of Vineyard Northeast.

1.1 Offshore Vineyard Northeast Elements and Construction Activities

The offshore Vineyard Northeast elements consist of WTGs and their foundations, ESPs and a booster station and their foundations, offshore export cables installed within two OECCs, and inter-array and inter-link cables. Construction activities include seafloor preparation and scour protection placement; WTG and ESP/booster foundation installation; offshore export, inter-array, and inter-link cable installation activities; HRG surveys; landfall site cofferdam installation/removal; construction vessel activity; and potential UXO detonation. All Vineyard Northeast elements and construction activities are described in Subsections 1.1.1–1.1.8 below. Each of these was assessed for their potential to result in marine mammal take. Activities that have the potential to result in marine mammal take are considered in Section 1.2 and activities not expected to result in marine mammal take are considered in Section 1.3.

1.1.1 WTG Foundation Installation

WTG foundations provide a stable, level base for WTG towers. Two WTG foundation concepts are included in the Vineyard Northeast PDE – monopiles and piled jackets. A monopile is a single, hollow cylindrical steel pile that is driven into the seabed. Typically, a separate steel transition piece is installed on top of the monopile. Alternatively, the monopile length can be extended to the interface with the WTG tower, which is referred to as an "extended monopile." Figure 2 shows a conceptual example of these two monopile alternatives. The maximum monopile diameter under the PDE is 14 m (46 ft).

A piled jacket foundation is a steel structure comprised of several legs connected by welded tubular cross bracing, which is secured to the seafloor using pin piles. Figure 3 shows a conceptual example of a WTG piled jacket foundation. The maximum pin pile diameter used for WTG jacket foundations under the PDE is 4.25 m (14 ft). Each WTG piled jacket foundation will include three or four legs, each secured with one pin pile, for a total of three or four pin piles per WTG piled jacket foundation.

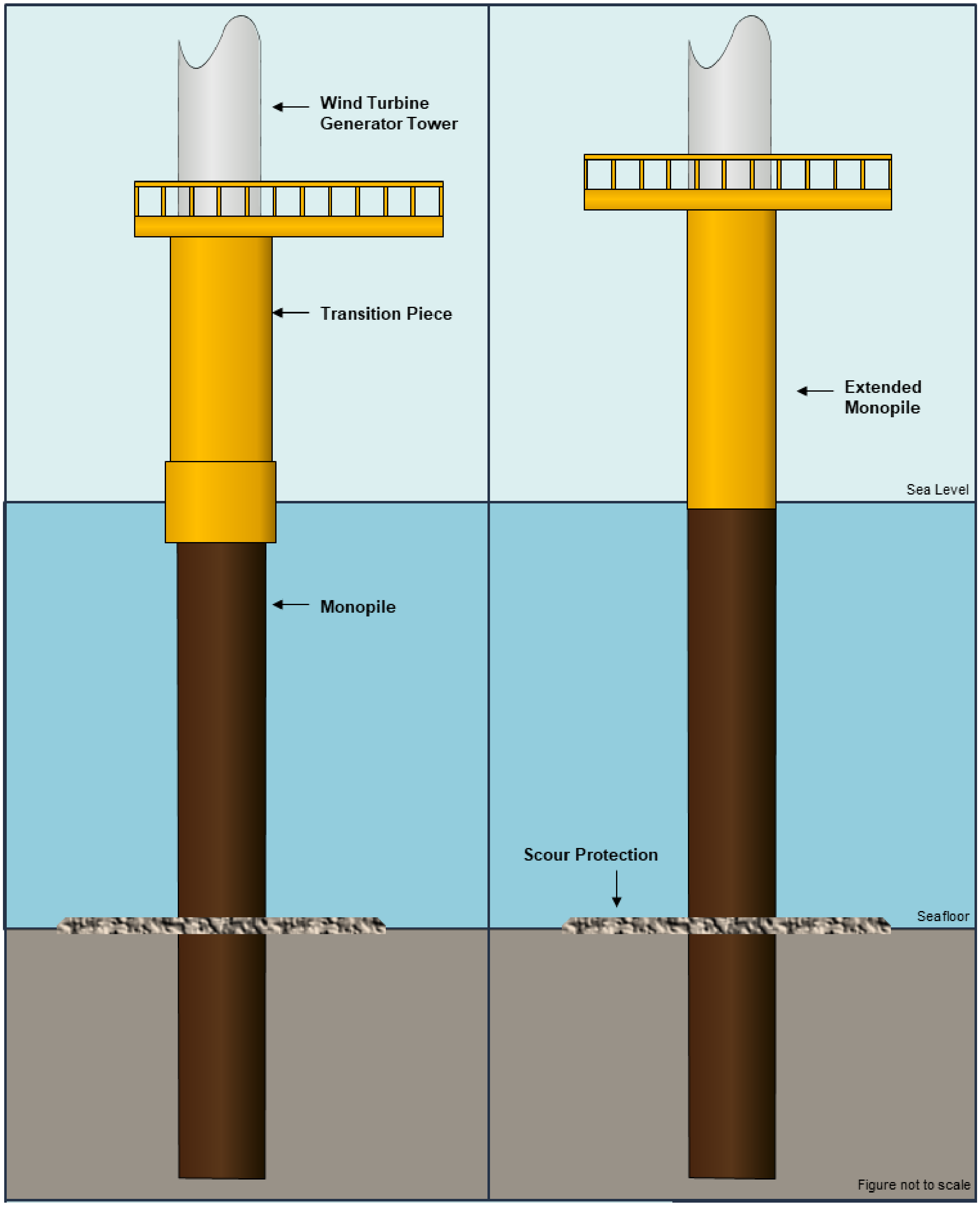

Figure 2. WTG monopile foundation.

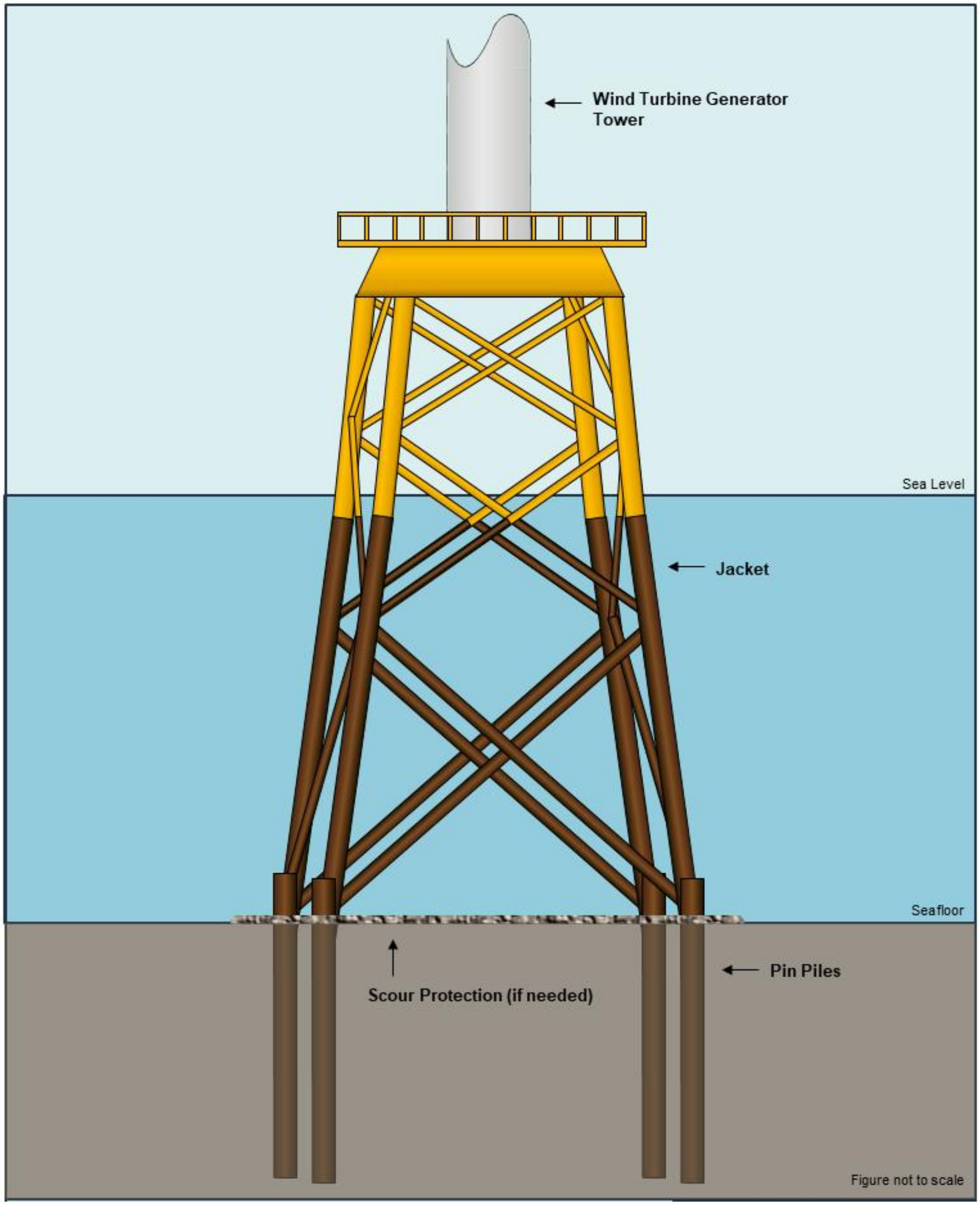

Figure 3. WTG piled jacket foundation.

1.1.1.1 WTG Monopile Foundation Installation

Monopiles will be installed by one or two jack-up vessels or heavy-lift vessels (HLVs) using dynamic positioning (DP) or anchors. Jack-up vessels are expected to use DP thrusters when positioning next to WTGs (until the spud cans make contact with the seafloor and pre-jack-up checks are completed). The thrusters will then be disengaged and the vessel will commence jacking-up. The use of DP thrusters and/or anchoring is highly dependent on the specific vessel employed for installation. The duration of use will also depend on sea conditions and the type of DP thrusters employed. All installation vessels are expected to use DP to position themselves for installation even if anchoring is being employed. Depending on final vessel selection, DP thrusters may also be used during pile driving if the vessel is a non-jack-up vessel.

At each foundation position, the main installation vessel will use a crane to upend and lower the monopile to the seabed. If a separate transport vessel is used, it is anticipated that the monopile will be lifted directly off the transport vessel, which could be moored to the main installation vessel. To stabilize the monopile's vertical alignment before and during piling, a pile frame may be placed on the seabed within the scour protection footprint, and later retrieved, or a pile gripper may extend from the side of the installation vessel. If used, the pile frame would be a template (usually made of metal) temporarily placed on the seafloor to guide the installation of the monopile. The pile frame is not secured to the seafloor and is removed following installation of the monopile. After the monopile is lowered to the seabed through the pile gripper/frame, the weight of the monopile will enable it to "self-penetrate" a fraction of the target penetration depth into the seafloor. The crane hook would then be released, and the impact pile driving hammer would be lifted and placed on top of the monopile. Alternatively, a vibratory hammer could be used to install the monopile through surficial sediments in a controlled fashion to avoid the potential for a "pile run," where the pile could drop quickly through looser surficial sediments and destabilize the installation vessel. The extent to which a vibratory hammer may be used will continue to be evaluated based on site-specific data and the selected contractor's installation methodologies. Once the pile has penetrated the surficial sediments and is stable, an impact hammer would be used for the remainder of the installation. Impact pile driving will begin with a soft-start, where initial sets of hammer strikes are delivered at a lower strike rate and energy (see Section **Error! Reference source not found.**). The hammer energy will gradually be increased based on the resistance that is experienced from the sediments.

Drilling could be required if pile driving encounters refusal (e.g., due to a large boulder or bedrock). If drilling is required, a rotary drilling unit would likely be installed on top of the monopile to loosen or remove obstructing material from the monopile's interior. Pile driving would then recommence.

After a monopile is installed, a transition piece is placed on top of the monopile using a vessel's crane (unless an extended monopile concept is used, see

Figure 2).

1.1.1.2 WTG Jacket Foundation Installation

Once delivered to the Lease Area, the jacket components will be installed by one or two DP, anchored, or jack-up vessels. The Proponent expects that piled jacket foundations for WTGs would be pre-piled, i.e., the pin piles would be installed before the jacket structure. After the main installation vessel's crane upends and lowers each pin pile to the seabed, impact pile driving will commence with a soft-start. After all pin piles are driven to their target depths, the jacket structure is lifted by the installation vessel's crane directly onto the piles, leveled, and the pin piles are affixed to the structure.

It is not anticipated that vibratory pile driving will be necessary for jacket pin piles. Vibratory pile setting is used to mitigate the potential for pile run. The size and weight of monopiles increases the potential for pile run, whereas jacket pin piles are smaller in diameter and weigh less than monopiles and therefore the risk of pile run is comparatively less. Vibratory hammers are also typically combined with lifting tools which aid in the upending and setting of large monopiles.

1.1.2 ESP/Booster Station Foundation Installation

Vineyard Northeast will include one to three offshore ESPs. ESPs collect the power generated by the WTGs and transform it to a higher voltage for transmission to shore. If HVDC offshore export cables are used, an HVDC ESP would be used. If HVAC offshore export cables are used to connect to an onshore transmission system in Massachusetts, an HVAC ESP would be used. In this scenario, because transmission losses in HVAC cables are greater than in HVDC cables, the Proponent would also need to install a booster station along the offshore export cables within the Massachusetts OECC (between the ESP and shore, in the northwestern aliquot of Lease Area OCS-A 0534) to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity.

As with WTG piled jacket foundations, the ESP/booster station jacket foundation is a steel structure comprised of several legs connected by welded tubular cross bracing, which is secured to the seafloor using pin piles. The maximum pin pile diameter under the PDE is 4.25 m (14 ft). The PDE includes a maximum of six legs, each secured with up to three pin piles, for a total of up to 18 pin piles per ESP/booster station piled jacket foundation. Figure 4 shows a representative diagram of the jacket foundation that would be used for both the ESPs and booster station.

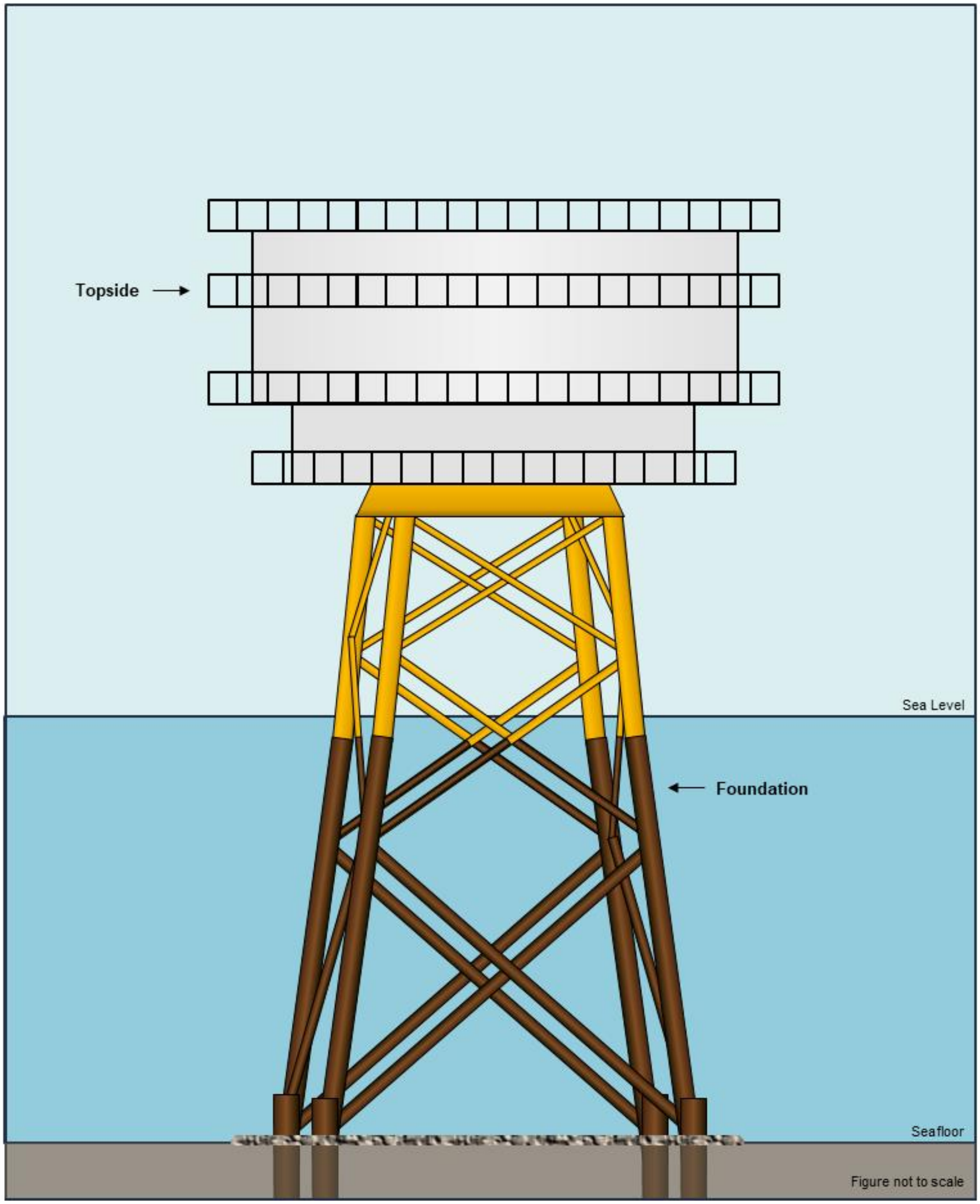

Figure 4. ESP/booster station piled jacket foundation.

Once delivered to the Lease Area, the jacket components will be installed by one or two DP, anchored, or jack-up vessels. ESP/booster station foundation installation is similar to WTG jacket foundation installation. However, the Proponent expects that piled jacket foundations for ESP(s) and the booster station are more likely to be post-piled, i.e., the jacket structure would be installed first and then the pin piles would be driven through pile "sleeves" or guides mounted to the base of each leg. Post-piled jacket structures may include mudmats at the base of each leg to distribute the jacket's weight and provide temporary support prior to pile driving. After the main installation vessel's crane upends and lowers each pin pile to the seabed, impact pile driving will commence with a soft-start.

1.1.3 Landfall Site Cofferdam Installation/Removal

Vineyard Northeast's offshore export cables will transition onshore at two landfall sites (one in Massachusetts and one in Connecticut). At each landfall site, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD). HDD is a trenchless installation method that avoids or minimizes impacts to the beach, intertidal zone, and nearshore areas. Prior to drilling, an onshore approach pit and offshore exit pit are excavated, and then bore holes are drilled between the onshore approach pit and the offshore exit pit in an arc beneath the beach and nearshore zone. One bore hole is needed for each offshore export cable/cable bundle. The bore holes are then enlarged, plastic or steel conduits are inserted into the holes, and the offshore export cables are pulled through the conduits towards shore.

At the HDD offshore exit pit, a temporary cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial. If used, the cofferdams will be constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. Up to two cofferdams could be installed at the Connecticut landfall site and up to three cofferdams could be installed at the Massachusetts landfall site. The cofferdams would also be removed likely using a vessel-mounted crane and vibratory hammer.

1.1.4 HRG Surveys

Offshore and nearshore geophysical surveys are expected to be conducted within the Lease Area and OECCs for activities such as pre-lay surveys, verifying site conditions, ensuring proper installation of components, conducting as-built surveys, inspecting the depth of cable burial, and inspecting foundations. Geophysical survey instruments may include side scan sonar, single and multibeam echosounders, magnetometers/gradiometers, and shallow (CHIRP) and medium (sparker) penetration single or multi-channel sub-bottom/seismic profilers. The final equipment that will be used during the proposed HRG survey activities will vary depending on the final survey design, vessel availability, and survey contractor selection.

1.1.5 UXO Detonation

UXOs are fired military munitions that remain unexploded by design or malfunction. Discarded military munitions (DMMs) are unfired military munitions that have been abandoned or improperly discarded. The Proponent has performed desktop studies to assess the potential risk from UXOs in the Lease Area and OECCs based on historical records and previous surveys. The desktop studies found there to be a moderate risk of encountering UXOs in the Lease Area and varying low and moderate risk of encountering UXOs in the OECCs. The Proponent expects to conduct UXO/DMM surveys to further investigate portions of the Lease Area and OECCs for the presence of UXO and DMM prior to the start of construction. Those surveys are expected to be completed prior to the term of the requested authorization.

If the surveys identify UXO/DMM within the Lease Area and/or OECCs, the Proponent will implement mitigation measures in accordance with the As Low As Reasonably Practical (ALARP) principle. The Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables around the object. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), the UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). For the purposes of impact analyses, the Proponent conservatively assumes that up to two UXOs in the Lease Area, four UXOs in the Massachusetts OECC, and four UXOs in the Connecticut OECC may need to be detonated in place.

1.1.6 Vessel Activity

Assuming the maximum design scenario for the full buildout of the Lease Area, it is estimated that an average of approximately 30 vessels would operate at the Lease Area or along the OECCs at any given time during offshore construction. During the most active period of construction, it is conservatively estimated that a maximum of approximately 66 vessels could operate in the Offshore Development Area[3] at one time. This includes vessels in the Lease Area, at the OECCs, and in transit to, from, or within a port. Up to approximately 4,200 total vessel round trips from ports are expected to occur during the busiest year of offshore construction. During the most active month of construction, it is anticipated that an average of approximately 21 daily vessel round trips from ports could occur. A summary of construction vessel activity is provided in Table 1. All offshore construction vessels will follow the vessel strike avoidance measures as described in Section **Error! Reference source not found.**.

[3] The Offshore Development Area is comprised of Lease Area OCS-A 0522, two OECCs (the Massachusetts OECC and Connecticut OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Northeast-related activities.

Table 1. Vessel types, expected numbers, expected numbers of round trips, expected years in use, and potential ports to be used during construction of Vineyard Northeast.

Vessel Type	No. of Each Type of Vessel	Expected Number of Round Trips to and from Port	Expected Years in Use	Expected Vessel Activity	Potential Ports
Anchor handling tug supply (AHTS) vessels	1–6	61	2028-2032	Vessels that primarily handle and reposition the anchors of other vessels (e.g., cable laying vessels), but may also be used to transport equipment or for other services.	**Massachusetts:** Brayton Point Commerce Center, Fall River Ports, Port of New Bedford, Salem Harbor, Vineyard Haven Harbor **Rhode Island:** Port of Davisville, Port of Providence, South Quay Terminal **Connecticut:** Port of Bridgeport, New London State Pier, Port of New Haven **New York:** Port of Albany-Rensselaer, NYS Offshore Wind Port, Port of Coeymans Marine Terminal, Arthur Kill Terminal, Homeport Pier, Red Hook Container Terminal, South Brooklyn Marine Terminal, GMD Shipyard, Shoreham, Port Jefferson Harbor, Greenport Harbor **New Jersey:** Paulsboro Marine Terminal, New Jersey Wind Port **Canada:**[1] Port of Halifax, Sheet Harbor, Port Saint John
Barges	2–10	182	2028-2032	Vessels with or without propulsion that may be used for transporting components (e.g., foundations, WTGs, etc.) or installation activities.	
Bunkering vessels	1–4	46	2028-2032	Vessels used to supply fuel and other provisions to other vessels offshore.	
Cable laying vessels and other specialized cable installation vessels	1–7	72	2028-2032	Specialized vessels/barges that lay and bury offshore cables into the seafloor and specialized vessels used to remove the upper portions of sand bedforms.	
Crew transfer vessels (CTVs)/safety vessels	2–12	4,651	2028-2032	Smaller vessels that transport crew, protected species observers, parts, and/or equipment and vessels that are used to address other mariners and fishing vessels entering active work sites.	
Heavy lift vessels (HLVs)	1–4	9	2029-2032	Vessels that may be used to lift, support, and orient the WTGs, ESP(s), booster station, and foundations during installation.	
Heavy transport vessels (HTVs)/modified cargo vessels	2–12	202	2028-2032	Ocean-going vessels that may transport components to staging ports or directly to the Lease Area.	

Jack-up vessels	1–9	50	2028-2032	Vessels that extend legs to the seafloor to provide a safe, stable working platform. Jack-up vessels may be used to install foundations, ESP and booster station topsides, and/or WTGs, to transport components to the Lease Area, for offshore accommodations, for cable splicing activities, and/or for cable pull-in at the landfall sites.
Scour/cable protection installation vessels	1–3	176	2028-2032	Vessels (e.g., fallpipe vessels) that may be used to deposit layer(s) of rock around the foundations or over limited sections of the offshore cable system.
Service operation vessels (SOVs)/ service accommodation and transfer vessels (SATVs)	1–3	142	2028-2032	Larger vessels that provide offshore living accommodations and workspace as well as transport crew to and from the Lease Area.
Support vessels	1–8	254	2028-2032	Multipurpose vessels (e.g., work boats, supply boats, accommodation vessels, diving support vessels, PSO support vessels) that may be used for a variety of activities, such as the pre-lay grapnel runs, supporting cable installation, commissioning WTGs, or transporting equipment.
Survey vessels	1–3	48	2028-2032	Specialized vessels used to perform geophysical, geotechnical, and environmental surveys.
Tugboats	2–16	422	2028-2032	Ocean-going vessels or smaller harbor craft used to transport equipment and barges.
Total Vessel Trips During Construction[2]		**6,000**		

[1]Analysis of potential Canadian ports that may be used is ongoing.

[2]The total number of round vessel trips is less than the sum of trips by vessel type because different vessel types may be used to perform the same activity.

1.1.7 Fisheries Monitoring Surveys

A draft fisheries monitoring plan for pre-, during, and post-construction fisheries surveys has been developed for Vineyard Northeast in accordance with the recommendations set forth in BOEM's 2023 Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf (BOEM 2023), which is designed to:

- Identify and confirm which dominant benthic, demersal, and pelagic species are using the project site, and the season(s) these species may be present where development is proposed;
- Establish a pre-construction baseline which may be used to assess whether detectable changes associated with proposed activities occurred in post-construction abundance and distribution of fisheries;
- Collect additional information aimed at reducing uncertainty associated with baseline estimates and/or to inform the interpretation of research results; and
- Develop an approach to quantify any substantial changes in the distribution and abundance of fisheries associated with proposed activities.

Additional documents and guidance considered when developing the plan include the Regional Wildlife Science Collaborative for Offshore Wind's (RWSC's) Integrated Science Plan for Offshore Wind, Wildlife, and Habitat in U.S. Atlantic Waters (RWSC 2024); Responsible Offshore Science Alliance's (ROSA's) 2021 Offshore Wind Project Monitoring Framework and Guidelines (ROSA 2021); the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy-Northeast U.S. Region (Hare et al. 2022); and Recommended Regional Scale Studies Related to Fisheries in the Massachusetts and Rhode Island-Massachusetts Offshore Wind Energy Areas (MassDMF 2018).

The fisheries survey protocols (described further below) were originally developed for Vineyard Wind 1 (Lease Area OCS-A 0501) in collaboration with the University of Massachusetts Dartmouth School for Marine Science & Technology (SMAST) and incorporate input from more than 75 commercial and recreational fishermen as well as academic and government resource agencies, including the National Marine Fisheries Service (NMFS) (also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries). The planned fisheries surveys for Lease Area OCS-A 0522 are anticipated to follow the same or similar protocols as the fisheries surveys conducted in Lease Area OCS-A 0501.

Fisheries monitoring surveys are anticipated to be carried out by scientists from SMAST, who have developed a number of fisheries monitoring survey protocols and have been conducting baseline fisheries monitoring surveys in the Lease Area since 2019. Vineyard Northeast's fisheries monitoring plan (pre-construction as well as during/post construction) will also draw upon the plan being implemented for Vineyard Wind 1, as appropriate. A summary of the fisheries monitoring surveys anticipated to be conducted are listed below in Table 2.

Table 2. Anticipated Fisheries Monitoring Surveys to be conducted by Vineyard Northeast.[1]

Anticipated Fisheries Survey Activity	Description	Take Requested	Risk Assessment and Mitigation Measures
Demersal Otter Trawl Survey	A seasonal trawl survey following the Northeast Area Monitoring and Assessment Program (NEAMAP) survey protocol to sample fish and invertebrate abundance, distribution, population structure, and community composition in the Lease Area and control area. There will be 20–40 tows per survey, with up to 4 surveys per year. Tow locations are randomly selected through a spatially balanced sampling design. Tows are expected to be conducted for ~20 minutes at a target speed of 3.0 knots.	None	Minimal risk. Marine mammal monitoring will be conducted prior to deployment, during survey, and during retrieval of nets (see Section **Error! Reference source not found.**). The survey vessel will follow mitigation measures as discussed below. (See the general measures in Section **Error! Reference source not found.** and measures specific to fisheries monitoring surveys in Section **Error! Reference source not found.**)
Ventless Trap Survey	A ventless trap survey following a protocol used by Massachusetts Division of Marine Fisheries (MA DMF), Rhode Island Department of Environmental Management (RI DEM), and other states to sample lobster, black sea bass, and Jonah crab. Following a random sampling design, surveys will be conducted twice per month from May 15 to October[2] at 30 or more stations across the Lease Area and control area. Sampling will utilize a string of 6 lobster traps and 1 fish pot at each station (using weak-link technology) with a target soak time of 3 – 5 days.	None	Minimal risk given the mitigation measures that will be implemented, as discussed in Sections **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**. As described in Section 11.3.4, Vineyard Northeast anticipates committing to the use of on-demand gear for all fixed fishing surveys. Vineyard Northeast will investigate safe and effective on-demand gear technology with the goal of eliminating all vertical lines from fixed fishing gear surveys.
Lobster Tagging Study	A tagging study conducted twice per month from May to October[2] in conjunction with the ventless trap survey to study more detailed, continuous tracking of lobster movements, for those with a carapace size of 40 millimeter or greater.	None	Minimal risk. Survey vessel will follow vessel mitigation measures as discussed in Sections **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**.
Neuston (surface zooplankton) Net Survey	A zooplankton survey monitoring at 30 or more stations across the Lease Area and control area, occurring concurrently with ventless trap surveys (i.e., two times per month from May to October). This survey will consist of ~10-minute tows at ~4.0 knots in the top 0.5 meters of the water column.	None	Minimal risk. Survey vessel will follow vessel mitigation measures as discussed in Sections **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**.

Drop Camera Survey	An underwater camera survey to assess benthic fish and invertebrates. Conducted twice annually between spring and fall (with a commercial scallop fishing vessel) within the Lease Area and control area. Placed 1.5 – 5.6 km apart, stations follow a centric systematic sampling grid design, with four high-resolution quadrat image samples per station.	None	Minimal risk. Survey vessel will follow vessel mitigation measures as discussed in Sections **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**.

[1] The proposed fisheries monitoring surveys are subject to change based on agency and stakeholder feedback.
[2] Per direction from the federal agencies, November sampling will not be included because of the potential presence of the NARW in the Lease Area.

1.1.8 Other Construction Activities

1.1.8.1 Seafloor Preparation and Scour Protection Installation

Seabed preparation may be required prior to scour protection or foundation installation. This could include removing large obstructions (e.g., boulders, marine debris), leveling the seafloor's surface (e.g., sand bedform leveling), and/or removing any surficial sediments that are too weak to support the foundation (if present). Any seabed preparation is expected to occur within the maximum scour protection footprint. Leveling the seafloor's surface could be accomplished in one of two ways: (1) using a trailing suction hopper dredge (TSHD) or (2) controlled flow excavation. With a TSHD, one or two suction arms extend from the side of a vessel toward the seafloor. The ends of the suction arm(s) are equipped with nozzles that direct pressurized seawater at the seafloor, loosening the seafloor sediments. The loosened sediments are then sucked up through the arm(s) into the vessel's hopper, thus leveling the seabed. The TSHD would deposit the dredged material within sandy areas in the Lease Area. Controlled flow excavation uses high volumes of pressurized water directed at the seafloor to push sediments aside. The controlled flow excavation tool would be deployed by a vessel.

Boulder clearance is expected to be accomplished by a grab tool suspended from a vessel's crane, which lifts individual boulders and relocates them elsewhere. Boulders relocated by crane would be placed in close proximity to their original location, but far enough away to avoid interference with other installation tools. To the maximum extent practicable, boulders will be relocated to avoid sensitive habitats and minimize seafloor impacts. Alternatively, a clearance plow may be towed by a vessel to push boulders aside.

Scour protection may be installed at the base of each WTG, ESP, and booster station foundation to minimize sediment transport and erosion (i.e., scour development) caused by water currents. It is anticipated that scour protection will be needed for the larger diameter monopiles but may or may not be needed for the smaller diameter pin piles used for piled jacket foundations. If used, scour protection would likely consist of loose rock material placed around the foundation in one or more layers. The Proponent expects to use a DP fallpipe vessel, which uses a pipe extending from the vessel's hopper to deposit rock in a controlled manner at the foundation position. A remotely operated vehicle (ROV) located at the bottom of the fallpipe would likely be used to control the lateral movement of the fallpipe and monitor the installation process. Other possible techniques are side dumping and placement using a crane/bucket.

1.1.8.2 WTG, ESP Topside, and Booster Station Topside Installation and Commissioning

At the Lease Area, the WTGs are expected to be installed by one or two main installation vessels, which may be a jack-up, anchored, or DP vessel. The WTG components will be lifted using the main installation vessel's crane and/or a "climbing crane" that crawls up the WTG tower (using the tower for support). The tower will be erected first, followed by the nacelle, and then the rotor (hub and blades). Alternatively, the nacelle and hub could be installed in a single operation followed by the installation of individual blades. If the tower consists of multiple sections, the sections will likely be joined with a bolted connection. A support vessel(s) (e.g., tugboat[s]) may remain at the Lease Area during the installation process to assist the main installation vessel. After installation, WTGs will be commissioned. This involves energizing the WTGs using power from the electrical grid or a temporary power supply and preparing them for operation. The WTG commissioning phase will likely occur in parallel with the WTG installation phase. The Proponent expects to use service operation vessels (SOVs), crew transfer vessels (CTVs), and/or helicopters to transport crew to and from the WTGs during commissioning.

The ESP and booster station topsides will be installed after their foundations are installed. The topside installation vessel, which will likely be an anchored, DP, or jack-up vessel, may be the same vessel that installs the foundations. After the installation vessel positions itself next to the foundation, the vessel's crane will likely lift the topside from its deck or a separate transport vessel and place it on the foundation. After mechanical installation of the topside is complete, the inter-array cables, offshore export cables, and/or inter-link cables (if used) will be pulled into place and terminated within the topside. Then, the ESP(s) and booster station will be energized and commissioned. During the commissioning period, a jack-up vessel or floating vessel (e.g., SOV) may be positioned near the ESP(s) and booster station to provide accommodations for workers performing commissioning activities.

1.1.8.3 Offshore Export, Inter-array, and Inter-link Cable Installation Activities

Offshore export cables will transmit electricity from the ESP(s) to landfall sites in Massachusetts and Connecticut. Prior to cable installation, the offshore export cable alignments may require boulder clearance and sand bedform leveling (see Section 1.1.8.1). Following those activities, pre-lay surveys (see Section 1.1.4) and pre-lay grapnel runs will be performed to confirm that the cable alignments are suitable for installation. The offshore export cables will then be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 m (5 to 8 ft)[4] using DP or anchored cable laying vessels. The majority of the offshore export cables are expected to be installed using jetting techniques (jet plowing or jet trenching) or a mechanical plow. Other specialty cable installation techniques may be used along limited sections of the offshore export cables, such as mechanical trenching, controlled flow excavation, or precision installation (i.e., a diver or ROV).

Inter-array cables connect strings of multiple WTGs to the ESP(s) and inter-link cables connect ESPs together. Prior to cable installation, the inter-array and inter-link cable alignments may require limited sand bedform leveling and boulder clearance, followed by pre-lay surveys (see Section 1.1.4) and pre-lay grapnel runs. The inter-array and inter-link cables will be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 m (5 to 8 ft).[5] Based on currently available technologies, the expected installation method for the inter-array cables is post-lay burial using a jetting technique. However, they may be installed using any of the methods and installation tools described for offshore export cables. Inter-link cable installation will follow a process similar to inter-array cable installation or offshore export

[4] Unless the final Cable Burial Risk Assessment (CBRA) indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

[5] Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

installation. Whereas inter-array cable installation is expected to use DP vessel(s), inter-link cable installation may be performed using a DP or anchored vessel.

The offshore cables may require cable protection if a sufficient burial depth cannot be achieved, if the cables need to cross other infrastructure (e.g., existing cables, pipelines, etc.), to secure the cable entry protection system in place (which is mounted around the cable where it enters the foundation for protection), or where a cable splice requires protection. Cable protection methods include freely laid rock, rock bags, concrete mattresses, and half-shell pipes (or similar).

1.2 Activities Resulting in Potential Take of Marine Mammals

1.2.1 WTG and ESP/Booster Station Foundation Installation

As noted above, WTG and ESP/booster station foundation installation will involve impact pile driving, vibratory pile setting, and potentially drilling. Sound generated by impact pile driving consists of regular, pulsed sounds of short duration. These pulsed sounds are typically high energy with fast rise times. Exposure to these sounds may result in Level A[6] (injurious) or Level B[7] (behavioral) harassment depending on proximity to the sound source and a variety of environmental and biological conditions (Nedwell et al. 2007; Dahl et al. 2015). Noise generated by vibratory pile setting and drilling is considered to be continuous and non-impulsive. Relative to impact pile driving, these two sound sources have minor contributions to the cumulative sound exposure levels used to estimate Level A harassment. However, continuous sounds are considered to have a greater potential to result in Level B harassment because of the lower sound threshold (SPL_{rms} 120 dB), which results in larger areas ensonified above the threshold level. An acoustic propagation and animal movement modeling study was conducted using industry standard models to estimate the potential effects to marine mammals of noise generated during foundation installation from vibratory pile setting and impact pile driving (Ozanich et al. 2024). That study report is attached to this application as Appendix A. Additionally, acoustic propagation modeling of drilling sounds was conducted to determine distances to the relevant acoustic impact thresholds and density-based exposure estimates were calculated (Appendix I of Appendix A). A summary of the model results as well as exposure and take estimates incidental to foundation installation are provided in Section 6.3.

1.2.2 Landfall Site Cofferdam Installation/Removal

As noted in Section 1.1.3 above, HDD activities at the landfall sites may involve the use of temporary, offshore cofferdams constructed of sheet piles that would be installed and removed using a vibratory hammer. Vibratory hammering produces non-impulsive, continuous sounds with low peak sound pressure levels (Buehler et al. 2015; Guan and Miner 2020) that can result in marine mammal take. Acoustic propagation modeling and density-based exposure estimation was conducted to estimate potential impacts to marine mammals incidental to cofferdam installation/removal at the landfall sites (Appendix K of Appendix A). A summary of the model results as well as exposure and take estimates incidental to cofferdam installation and removal are provided in Section 6.6.

[6] Level A refers to marine mammal harassment as defined in the Marine Mammal Protection Act (MMPA) that could potentially cause permanent threshold shift (PTS) or auditory injury.
[7] Level B refers to marine mammal harassment as defined in the MMPA that could potentially cause behavioral disturbance.

Other than the installation/removal of cofferdams using a vibratory hammer, HDD is not expected to result in marine mammal take.

1.2.3 HRG Surveys

HRG survey instruments that use operating frequencies below 180 kHz are audible to marine mammals and have the potential to result in marine mammal take (MacGillivray et al. 2014). Those with operating frequencies above 180 kHz are outside the hearing range of marine mammals and will not cause take. Despite generating sounds at frequencies below 180 kHz, certain characteristics of the signals produced by some HRG survey instruments mean that they are unlikely to cause take of marine mammals (categorized as Tier 4 sources in Ruppel et al. (2022)). For example, parametric sub-bottom profilers produce very narrowly focused beams of sound (1–3.5°) at relatively high frequencies (85–100 kHz) that attenuate rapidly in water and are therefore not expected to cause take of marine mammals (NMFS 2022). Similarly, the sounds from ultra-short baseline (USBL) systems, which are used for high-accuracy positioning of survey equipment and vessels, are expected to produce extremely short propagation distances under typical operating conditions so are also not expected to result in take (NMFS 2022).

The frequency range and signal characteristics of sparkers, boomers, and non-parametric sub-bottom profilers (i.e., CHIRP) may cause behavioral take. The final equipment that will be used during the proposed HRG survey activities will vary depending on the final survey design, vessel availability, and survey contractor selection. In order to assess impacts of this activity, a selection of HRG equipment (Table 3) was used to estimate potential horizontal impact distances to regulatory-defined Level A and B harassment thresholds, and density-based Level B exposure and take estimates were calculated. Details of this assessment are provided in Section 6.4.

Table 3. Example HRG survey equipment with operating frequencies below 180 kHz.

Equipment Type	Example System	Frequency (kHz)
Non-parametric sub-bottom profiler	EdgeTech Chirp 216	2–16
Boomer	Applied Acoustics AA251 Boomer	0.2–15
Sparker	GeoMarine Geo Spark 2000 (400 tip)	0.05–3

1.2.4 UXO Detonation

Underwater detonations of UXOs create broadband impulsive sounds with high peak pressures and rapid rise times (Richardson et al. 1995). UXOs with more net explosive weight will produce higher peak pressures. At close ranges, these sounds have the potential to cause non-auditory injury to marine mammals and at longer ranges, auditory injury (Level A harassment) and behavioral disturbance (Level B harassment) are possible. The Proponent will prioritize avoidance, relocation, and other non-explosive methods of disposal; however, for the purpose of this impact analysis, it was conservatively assumed that up to two UXOs in the Lease Area, four UXOs in the Massachusetts OECC, and four UXOs in the Connecticut OECC may need to be detonated in place. Acoustic propagation modeling of UXO detonation was conducted to determine distances to the relevant acoustic impact thresholds for underwater detonations, and density-based exposure estimates were calculated using these assumptions (Appendix J of Appendix A). A summary of the model results as well as exposure and take estimates incidental to UXO detonations are provided in Section 6.5.

1.3 Activities Not Resulting in Potential Take of Marine Mammals

Construction vessels would be stationary on site for significant periods of time and the large vessels would travel to and from the site at low speeds, which would produce lower noise levels than vessel transit at higher speeds. Routine vessel activities such as transits between ports and the Lease Area and OECCs or between worksites within those areas are not anticipated to cause take of marine mammals. Vineyard Northeast activities such as seabed preparation (i.e., seafloor leveling and sediment or boulder removal), placement of scour protection, installation of WTGs and ESP/booster station topsides, and cable installation are not expected to produce sounds above those of routine vessel activities, and thus are not considered to result in marine mammal take. Seafloor disturbance related to these activities is expected to largely resolve once construction is completed and is considered unlikely to result in marine mammal take. This is discussed further in Section 9.1.2. Likewise, no take is expected for fisheries monitoring surveys given the mitigation measures that will be implemented (Sections **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**). These activities are, therefore, not considered further in this application.

As part of various offshore construction related activities, including cable laying and construction material delivery, DP thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of DP thrusters is similar to that produced by transiting vessels and DP thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. Sound produced by DP 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 (87 FR 79072). Because DP thrusters are not expected to result in take of marine mammals, this sound source is not analyzed further in this document.

2 Dates, Duration, and Specified Geographic Region

2.1 Dates of Construction Activities

Table 4 (Schedule A) and Table 5 (Schedule B) provide an overview of the timing of construction activities that could result in marine mammal take during the 5 years of the requested authorization, which is assumed to be 2028–2032. Throughout this request, these are referred to as years 1 through 5, with calendar years in parentheses. Each of the activities that could result in marine mammal take is described in detail in Section 1. Details of the impact analyses and the detailed schedules used in these analyses are provided in Section 6.

For the purpose of the impact analysis, it was presumed that foundation installation could occur over a period of either 2 years (Schedule A, see

Table 4) or 4 years (Schedule B, see Table 5). The 2-year foundation installation schedule assumes a smaller WTG model, which will allow construction to proceed more quickly. The 4-year schedule assumes a larger WTG model, which will require a longer construction period due to larger monopiles and/or the installation of additional jackets. Under Schedule A, foundation installation occurs in years 3–4 (2030–2031). Under Schedule B, foundation installation occurs in years 2–5 (2029–2032). Under each of these schedules, foundation installation would be planned only during the months of the year when North Atlantic right whales are unlikely to be present (see Section **Error! Reference source not found.** for further discussion of seasonal restrictions on foundation installation). Foundation installation includes impact pile driving, vibratory pile setting prior to impact pile driving, and potentially drilling (if pile refusal is encountered). Under both schedules, impact pile driving is used during all years of foundation installation, whereas vibratory pile setting prior to impact piling primarily occurs in the latter portion of the construction period. Drilling could be required in any year of foundation installation; however, for the purpose of the impact analysis, it was assumed that any drilling would only occur during one year of either schedule (year 4 [2031]).

Table 4. Schedule A, Full Buildout: High-level schedule of construction activities that could result in marine mammal take.

Activity	Year 1 2028	Year 2 2029	Year 3 2030	Year 4 2031	Year 5 2032
Foundation installation[a]			X	X	
Cofferdam installation/removal		X	X		
Potential UXO detonation		X			
HRG surveys	X	X		X	

[a] Foundation installation activities include impact pile driving, vibratory pile setting, and drilling.

Table 5. Schedule B, Full Buildout: High-level schedule of construction activities that could result in marine mammal take.

Activity	Year 1 2028	Year 2 2029	Year 3 2030	Year 4 2031	Year 5 2032
Foundation installation[a]		X	X	X	X
Cofferdam installation/removal	X	X	X	X	
Potential UXO detonation	X		X		
HRG surveys	X	X			X

[a] Foundation installation activities include impact pile driving, vibratory pile setting, and drilling.

Under Schedule A, the impact analysis assumes that all potential UXO detonations would occur during year 2 (2029), that pre-construction HRG surveys would occur during years 1 and 2 (2028 and 2029), that post-construction HRG surveys would occur during year 4 (2031), and that cofferdam installation and removal at the landfall sites would occur during years 2 and 3 (2029 and 2030), respectively (

Table 4). Under Schedule B, the impact analysis assumes that potential UXO detonations would occur during years 1 and 3 (2028 and 2030), that pre-construction HRG surveys would occur during years 1 and 2 (2028 and 2029), that post-construction HRG surveys would occur during year 5 (2032), that cofferdam installation at the landfall sites would occur during years 1 and 3 (2028 and 2030), and that cofferdam removal would occur during years 2 and 4 (2029 and 2031) (Table 5).

The full buildout of Vineyard Northeast will be split into Project 1 and Project 2 approximately evenly between the northeastern and southwestern halves of the Lease Area in terms of foundation positions. As described in Section 1, Project 1, which will be installed first, will be located in the northeastern portion of the Lease Area and will be comprised of up to 84 WTG foundations and two ESP/booster station foundations. For Project 1, all WTG foundations are expected to be monopiles. Project 2, which will be installed following the completion of Project 1, will be located in the southwestern portion of the Lease Area and will be comprised of up to 83 WTG foundations and two ESP/booster station foundations. Due to water depths and geologic conditions, Project 2 is likely to require the use of a combination of monopile and jacket foundations (with a maximum of 60 jacket foundations). Jacket foundations for WTGs are included as an option in the southwestern portion of the Lease Area (i.e., where Project 2 will be located) given the water depths and sediment conditions. Specifically, water depths within the Lease Area are deepest in the southwestern portion. Jacket foundations offer greater installability with less weight compared to monopiles in these deeper water depths. The southwestern portion of the Lease Area also has softer fine-grained sediments, and jackets offer greater stability in these sediments than monopiles. There is a potential overlap area between the two projects consisting of 10 foundation positions that could be allotted to either Project 1 or Project 2.

Under Schedule A, assuming the maximum size of Project 1, foundation installation for Project 1 would be completed primarily during year 3 (2030), with five additional monopiles installed at the beginning of year 4 (2031). The year 3 (2030) foundation installation schedule for Project 1 is identical to the year 3 (2030) foundation installation schedule for the full buildout of Vineyard Northeast under Schedule A. Assuming the maximum size of Project 2, foundation installation for Project 2 would begin with the installation of five monopiles at the end of year 3 (2030) but would primarily be completed during year 4 (2031). The year 4 (2031) foundation installation schedule for Project 2 is identical to the year 4 (2031) foundation installation schedule for the full buildout scenario under Schedule A. Table 6 provides an overview of construction activities under Schedule A for the full buildout, Project 1, and Project 2.

Under Schedule B, assuming the maximum size of Project 1, Project 1 would be installed during years 2 and 3 (2029 and 2030). For Project 1, the year 2 (2029) schedule is the same as the full buildout under Schedule B, but the year 3 (2030) schedule includes five additional monopiles relative to the full buildout scenario. Assuming the maximum size of Project 2, Project 2 would be installed during years 4 and 5 (2031 and 2032). The year 5 (2032) schedule for Project 2 is the same as the full buildout under Schedule B, but the year 4 (2031) schedule for Project 2 includes five additional monopiles relative to the full buildout scenario. Table 7 provides an overview of construction activities under Schedule B for the full buildout, Project 1, and Project 2.

These schedules are for the maximum size of each project individually. However, if all 10 positions in the overlap area were allocated to Project 1, the foundation installation schedule for Project 2 would be shorter. Conversely, if all 10 positions in the overlap area were allocated to Project 2, the foundation installation schedule for Project 1 would be shorter.

Detailed schedules, showing the numbers and types of foundations to be installed during each month and each year for the full buildout of Vineyard Northeast as well as for Project 1 and Project 2 individually are provided in Section 6.3.

Table 6. Schedule A, Full Buildout, Project 1, and Project 2: Schedule of construction activities that could result in marine mammal take.

Activity		Year 1 (2028)	Year 2 (2029)	Year 3 (2030)	Year 4 (2031)	Year 5 (2032)
Foundation installation[a]	Full buildout			X (79 WTG MPs, 2 ESP jackets)	X (51 WTG MPs w/ vib, 27 WTG jackets, 2 ESP jackets, 5d drilling)	
	Project 1			X (79 WTG MPs, 2 ESP jackets)	X (5 WTG MPs w/ vib)	
	Project 2			X (5 WTG MPs)	X (51 WTG MPs w/ vib, 27 WTG jackets, 2 ESP jackets, 5d drilling)	
Cofferdam installation/ removal	Full buildout		X (5 installed in OECCs)	X (5 removed from OECCs)		
	Project 1		X (2 installed in CT OECC)	X (2 removed from CT OECC)		
	Project 2		X (3 installed in MA OECC)	X (3 removed from MA OECC)		
Potential UXO detonation	Full buildout		X (2 in Lease Area, 8 in OECCs)			
	Project 1		X (1 in Lease Area, 4 in CT OECC)			
	Project 2		X (1 in Lease Area, 4 in MA OECC)			
HRG surveys	Full buildout	X (Lease Area, CT OECC)	X (Lease Area, MA OECC)		X (Lease Area, both OECCs)	
	Project 1	X (Lease Area, CT OECC)			X (Lease Area, CT OECC)	
	Project 2		X (Lease Area, MA OECC)		X (Lease Area, MA OECC)	

MP = monopile; ESP = ESP or booster station; d = day; w/vib = vibratory pile setting followed by impact pile driving, CT OECC = Connecticut Offshore Export Cable Corridor; MA OECC = Massachusetts Offshore Export Cable Corridor

Table 7. Schedule B, Full Buildout, Project 1, and Project 2: Schedule of construction activities that could result in marine mammal take.

Activity		Year 1 (2028)	Year 2 (2029)	Year 3 (2030)	Year 4 (2031)	Year 5 (2032)
Foundation installation[a]	Full buildout		X (40 WTG MPs, 1 ESP jacket)	X (39 WTG MPs, 1 ESP jacket)	X (18 WTG MPs w/ vib, 21 WTG jackets, 1 ESP jacket, 5d drilling)	X (39 WTG jackets, 1 ESP jacket)
	Project 1		X (40 WTG MPs, 1 ESP jacket)	X (39 WTG MPs, 5 WTG MPs w/ vib, 1 ESP jacket)		
	Project 2				X (18 WTG MPs w/ vib, 5 WTG MPs, 21 WTG jackets, 1 ESP jacket, 5d drilling)	X (39 WTG jackets, 1 ESP jacket)
Cofferdam installation/ removal	Full buildout	X (2 installed in CT OECC)	X (2 removed from CT OECC)	X (3 installed in MA OECC)	X (3 removed from MA OECC)	
	Project 1	X (2 installed in CT OECC)	X (2 removed from CT OECC)			
	Project 2			X (3 installed in MA OECC)	X (3 removed from MA OECC)	
Potential UXO detonation	Full buildout	X (1 Lease Area, 4 in CT OECC)		X (1 Lease Area, 4 in MA OECC)		
	Project 1	X (1 Lease Area, 4 in CT OECC)				
	Project 2			X (1 Lease Area, 4 in MA OECC)		
HRG surveys	Full buildout	X (Lease Area, CT OECC)	X (Lease Area, MA OECC)			X (Lease Area, both OECCs)
	Project 1	X (Lease Area, CT OECC)				X (Lease Area, CT OECC)
	Project 2		X (Lease Area, MA OECC)			X (Lease Area, MA OECC)

MP = monopile; ESP = ESP or booster station; d = day; w/vib = vibratory pile setting followed by impact pile driving; CT OECC = Connecticut Offshore Export Cable Corridor; MA OECC = Massachusetts Offshore Export Cable Corridor

2.2 Specified Geographic Region of Activities

Offshore construction activities for Vineyard Northeast will occur within Lease Area OCS-A 0522 and along the OECCs from the Lease Area to landfall sites in Connecticut and Massachusetts (Figure 1). The Lease Area and OECCs are within the Mid-Atlantic Bight Northeast Shelf marine ecosystem (NOAA Integrated Ecosystem Assessment Northeast Region, https://www.integratedecosystemassessment.noaa.gov/regions/northeast/mid-atlantic-bight).

3 Species and Number of Marine Mammals

3.1 Species Present

There are 39 marine mammal species under NMFS jurisdiction in the Western North Atlantic Outer Continental Shelf (OCS) Region that are protected under the MMPA and whose ranges include the Northeastern US region where the Offshore Development Area is located (Hayes et al. 2023). The marine mammal assemblage comprises cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). There are 35 cetacean species, including 29 members of the suborder Odontoceti (toothed whales, dolphins, and porpoises) and six of the suborder Mysticeti (baleen whales) within the region, as well as four phocid pinniped species (true seals) that are known to occur in the region (Hayes et al. 2023). Five of the species known to occur in the Western North Atlantic are listed as endangered under the Endangered Species Act (ESA); these are the fin whale (*Balaenoptera physalus*), sei whale (*B. borealis*), blue whale (*B. musculus*), North Atlantic right whale (*Eubalaena glacialis*), and sperm whale (*Physeter macrocephalus*).

Table 8 provides the protection status, habitat preference, expected occurrence and seasonality in the Massachusetts Wind Energy Area (MA WEA), and NMFS stock name and abundance estimate of each of the 39 marine mammal species with geographic ranges that overlap with the Offshore Development Area. As shown in Table 8, the occurrence of these species in the MA WEA can be categorized as common (i.e., occur consistently in moderate to large numbers), uncommon (occur in low numbers or on an irregular basis), or rare (i.e., range includes the MA WEA but due to habitat preference and based on sighting information they are unlikely to occur there even though records may exist for adjacent waters). Information on occurrence in the MA WEA is based on NMFS stock assessments (NMFS 2024a); a data review (Kenney and Vigness-Raposa 2010) and aerial surveys (Kraus et al. 2016; O'Brien et al. 2020; 2021, 2022; 2023) focused on the WEAs; Atlantic Marine Assessment Program for Protected Species (AMAPPS) annual (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022) and final (Palka et al. 2017; 2021) reports; and PSO data gathered during Vineyard Northeast 2019 and 2022-2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024) and PSO sightings in nearby areas (Vineyard Wind 2019, 2021).

The 21 North Atlantic species for which take is being requested are shown in bold in Table 8. Most of these are considered to be either common or uncommon in the MA WEA. Based on PSO data, AMAPPS data, and other survey data, however, the Proponent is requesting Level B take for four species considered to be rare – blue whale, false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), and white-beaked dolphin (*Lagenorhynchus albirostris*). Blue whales have been sighted offshore of the Offshore Development Area during AMAPPS surveys (NEFSC and SEFSC 2017, 2022). False killer whales, killer whales, and white-beaked dolphins have been sighted during nearby HRG surveys (Vineyard Wind 2019, 2021). Additionally, the Proponent is requesting take for one species considered to be extralimital – gray whale (*Eschrichtius robustus*). On March 1, 2024, a single gray whale was observed swimming within the Lease Area during a New England Aquarium (NEAq) aerial survey (NEAq 2024a). Because this species is extinct in the North Atlantic, it is presumed that this animal migrated from the North Pacific into the North Atlantic through the Northwest Passage, which has regularly been ice-free during the summer in recent years due to rising global temperatures, and is likely the same whale observed off Florida in December 2023 (NEAq 2024b). When species not listed in an LOA are encountered and may be taken, it is necessary to cease survey and construction activities to avoid unauthorized take. To avoid this potential disruption to survey and construction activities, Vineyard Northeast is requesting a limited number of take for these five species.

Nineteen other species are expected to be rare within the Offshore Development Area because, although they occur in the wider North Atlantic OCS region, their known preferred habitats and distributions do not overlap with the Offshore Development Area, and no sightings exist for this area (Kenney and Vigness-Raposa 2010; Kraus et al. 2016; Roberts et al. 2016; Costa et al. 2022; Hayes et al. 2023; Roberts et al. 2023; Roberts et al. 2024) (Table 8). These are – Blainville's beaked whale (*Mesoplodon densirostris*), Cuvier's beaked whale (*Ziphius cavirostris*), Clymene dolphin (*Stenella clymene*), dwarf sperm whale (*Kogia sima*), Fraser's dolphin (*Lagenodelphis hosei*), Gervais' beaked whale (*Mesoplodon europaeus*), melon-headed whale (*Peponocephala electra*), northern bottlenose whale (*Hyperoodon ampullatus*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), pygmy sperm whale (*Kogia breviceps*), rough-toothed dolphin (*Steno bredanensis*), Sowerby's beaked whale (*Mesoplodon bidens*), spinner dolphin (*Stenella longirostris*), striped dolphin (*Stenella coeruleoalba*), Tamanend's bottlenose dolphin (*Tursiops erebennus*), True's beaked whale (*Mesoplodon mirus*), harp seal (*Pagophilus groenlandicus*), and hooded seal (*Crysophora cristata*). Tamanend's bottlenose dolphin was recently determined to be a separate species from the common bottlenose dolphin (*Tursiops truncatus*), rather than a coastal ecotype of this species (Costa et al. 2022). The range of Tamanend's bottlenose dolphin does not extend as far north as the Offshore Development Area (Costa et al. 2022) and thus it is unlikely to occur there. These 19 species are not considered further in this request.

Table 8. Marine mammals that could be present[8] in the Offshore Development Area. Those shown in bold are the species for which take is being requested.

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Habitat[b]	Occurrence in MA WEA[c]	Seasonality in MA WEA[c]	Abundance[d] (NMFS best available)
Mysticetes					
Blue whale (*Balaenoptera musculus*) Western North Atlantic Stock	Endangered/ Strategic	Pelagic and coastal	Rare	Mainly winter, but rare year-round[h]	402
Fin whale (*Balaenoptera physalus*) Western North Atlantic Stock	Endangered/ Strategic	Slope, pelagic	Common	Year-round, but mainly spring and summer	6,802
Gray whale (*Eschrichtius robustus*) Eastern North Pacific Stock	Endangered/ Strategic	Nearshore	Extralimital	NA	26,960
Humpback whale (*Megaptera novaeangliae*) Gulf of Maine Stock	Not Listed/Not Strategic	Mainly nearshore and banks	Common	Year-round, but mainly spring and summer	1,396
Minke whale (*Balaenoptera acutorostrata*) Canadian East Coast Stock	Not Listed/Not Strategic	Coastal, shelf	Common	Spring, summer, and fall (March to September)	21,968
North Atlantic right whale (*Eubalaena glacialis*) Western North Atlantic Stock	Endangered/ Strategic	Coastal, shelf, offshore	Common	Winter and spring (December to May)	340
Sei whale (*Balaenoptera borealis*) Nova Scotia Stock	Endangered/ Strategic	Mostly pelagic	Common	Spring and summer (March to June)	6,292
Odontocetes					
Atlantic spotted dolphin (*Stenella frontalis*) Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf, slope	Uncommon	NA	31,506
Atlantic white-sided dolphin (*Lagenorhynchus acutus*) Western North Atlantic Stock	Not Listed/Not Strategic	Offshore, slope	Common	Year-round	93,233
Blainville's beaked whale (*Mesoplodon densirostris*) Western North Atlantic Stock	Not Listed/Not Strategic	Slope, offshore	Rare	NA	2,936

[8] Gray whales are not anticipated to be seen within the Offshore Development Area; however, based on the requested take for the species described in Section 6, they are included within this table.

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Habitat[b]	Occurrence in MA WEA[c]	Seasonality in MA WEA[c]	Abundance[d] (NMFS best available)
Clymene dolphin (*Stenella clymene*) Western North Atlantic Stock	Not Listed/Not Strategic	Off continental shelf	Rare	NA	21,778
Common dolphin (*Delphinus delphis*) Western North Atlantic Stock	Not Listed/Not Strategic	Shelf, pelagic	Common	Year-round, but more abundant in summer	93,100
Common bottlenose dolphin (*Tursiops truncatus*) Western North Atlantic Offshore Stock	Not Listed/Not Strategic	Coastal, shelf, deep	Common	Year-round	64,587
Tamanend's bottlenose dolphin[g] (*Tursiops erebennus*) Western North Atlantic Northern Migratory Coastal	Not Listed/ Strategic	Coastal, shelf, deep	Rare	NA	6,639
Cuvier's beaked whale (*Ziphius cavirostris*) Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic	Rare	NA	2,936
Dwarf sperm whale (*Kogia sima*) Western North Atlantic Stock	Not Listed/Not Strategic	Deep, shelf, slope	Rare	NA	9,474[e]
False killer whale (*Pseudorca crassidens*) Western North Atlantic Stock	Not Listed/Not Strategic	Slope, offshore	Rare	NA	1,298
Fraser's dolphin (*Lagenodelphis hosei*) Western North Atlantic Stock	Not Listed/ Not Strategic	Pelagic, shelf	Rare	NA	Unknown
Gervais' beaked whale (*Mesoplodon europaeus*) Western North Atlantic Stock	Not Listed/Not Strategic	Slope, offshore	Rare	NA	8,595
Harbor porpoise (*Phocoena phocoena*) Gulf of Maine/Bay of Fundy Stock	Not Listed/Not Strategic	Shelf	Common	Year-round, but less abundant in summer	85,765
Killer Whale (*Orcinus orca*) Western North Atlantic Stock	Not Listed/Not Strategic	Offshore and mid-ocean	Rare	NA	Unknown
Melon-headed whale (*Peponocephala electra*) Western North Atlantic Stock	Not Listed/ Not Strategic	Pelagic	Rare	NA	Unknown
Northern bottlenose whale (*Hyperoodon ampullatus*) Western North Atlantic Stock	Not Listed/ Not Strategic	Deep, pelagic	Rare	NA	Unknown

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Habitat[b]	Occurrence in MA WEA[c]	Seasonality in MA WEA[c]	Abundance[d] (NMFS best available)
Pantropical spotted dolphin (*Stenella attenuata*) Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic	Rare	NA	2,757
Pilot whale, long-finned (*Globicephalus melas*) Western North Atlantic Stock	Not Listed/Not Strategic	Continental shelf edge, high relief	Uncommon	Year-round	39,215
Pilot whale, short-finned (*Globicephalus macrorhynchus*) Western North Atlantic Stock	Not Listed/Strategic	Pelagic, high relief	Uncommon	Year-round	18,726
Pygmy killer whale (*Feresa attenuata*) Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic	Rare	NA	Unknown
Pygmy sperm whale (*Kogia breviceps*) Western North Atlantic Stock	Not Listed/Not Strategic	Pelagic	Rare	NA	9,474[e]
Risso's dolphin (*Grampus griseus*) Western North Atlantic Stock	Not Listed/Not Strategic	Shelf, slope	Uncommon	Year-round	44,067
Rough toothed dolphin (*Steno bredanensis*) Western North Atlantic Stock	Not Listed/ Not Strategic	Pelagic, nearshore	Rare	NA	Unknown
Sowerby's beaked whale (*Mesoplodon bidens*) Western North Atlantic Stock	Not Listed/Not Strategic	Slope, offshore	Rare	NA	492
Sperm whale (*Physeter macrocephalus*) North Atlantic Stock	Endangered/ Strategic	Pelagic, steep topography	Uncommon	Mainly summer and fall	5,895
Spinner dolphin (*Stenella longirostris*) Western North Atlantic Stock	Not Listed/ Not Strategic	Pelagic, deep	Rare	NA	3,181
Striped dolphin (*Stenella coeruleoalba*) Western North Atlantic Stock	Not Listed/Not Strategic	Off continental shelf	Rare	NA	48,274
True's beaked whale (*Mesoplodon mirus*) Western North Atlantic Stock	Not Listed/Not Strategic	Slope, offshore	Rare	NA	4,480
White-beaked dolphin (*Lagenorhynchus albirostris*) Western North Atlantic Stock	Not Listed/Not Strategic	Off continental shelf	Rare	NA	536,016

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Habitat[b]	Occurrence in MA WEA[c]	Seasonality in MA WEA[c]	Abundance[d] (NMFS best available)
Pinnipeds					
Gray seal (*Halichoerus grypus*) Western North Atlantic Stock	Not Listed/Not Strategic	Nearshore, shelf	Common	Year-round	27,911
Harbor seal (*Phoca vitulina*) Western North Atlantic Stock	Not Listed/Not Strategic	Coastal	Common	Year-round, but rare in summer	61,336
Harp seal (*Pagophilus groenlandicus*) Western North Atlantic Stock	Not Listed/Not Strategic	Nearshore	Rare	Winter and spring	7.6 M[f]
Hooded Seal (*Crysophora cristata*) Western North Atlantic Stock	Not Listed/Not Strategic	Off continental shelf	Rare	NA	Unknown

NA = Not applicable and/or insufficient data available to determine seasonal occurrence in the offshore development area.
[a] Listing status under the US Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).
[b] Habitat descriptions are from NMFS Marine Mammal Stock Assessment Reports (Hayes et al. 2023; NMFS 2024a).
[c] Occurrence and seasonality in the Massachusetts Wind Energy Area (MA WEA) are derived from NMFS stock assessments (Hayes et al. 2023; NMFS 2024a), a data review (Kenney and Vigness-Raposa 2010) and aerial surveys (Kraus et al. 2016; O'Brien et al. 2020; 2021, 2022; 2023) focused on the WEAs, Atlantic Marine Assessment Program for Protected Species (AMAPPS) annual (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022) and final (Palka et al. 2017; 2021) reports, as well as PSO data gathered during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024).
[d] "Best Available" abundance estimate is from NMFS (2024a).
[e] Estimate includes both dwarf and pygmy whales.
[f] Estimate is for the entire population, including waters outside the U.S.
[g] Tamanend's bottlenose dolphin was recently determined to be a separate species from the common bottlenose dolphin (Tursiops truncatus), rather than a coastal ecotype of this species (Costa et al. 2022).
[h] Kraus et al. 2016; Muirhead et al. 2018; NEFSC & SEFSC 2017; 2022; Zoidis et al. 2021.

4 Affected Species Status and Distribution

4.1 Mysticetes

4.1.1 Blue Whale (Balaenoptera musculus)

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. Most adults are 23 to 27 m (75 to 90 feet) in length (Jefferson et al. 2008). Blue whales feed almost exclusively on krill (Kenney and Vigness-Raposa 2010).

Blue whales are considered low-frequency cetaceans in terms of their classification in the acoustic categories assigned by NMFS for the purposes of assessment of the potential for harassment or injury arising from exposure to anthropogenic noise sources, a group whose hearing is estimated to range from 7 Hz to 35 kHz (NMFS 2018). Peak frequencies of blue whale vocalizations range from roughly 10 to 120 Hz; an analysis of calls recorded since the 1960s indicates that the tonal frequency of blue whale calls has decreased over the past several decades (McDonald et al. 2009).

4.1.1.1 Distribution

Blue whales are found in all oceans, including at least two distinct populations inhabiting the eastern and western North Atlantic Ocean (Sears et al. 2005). Although blue whales spend most of their time in deep open ocean waters, there are summertime feeding aggregations of western North Atlantic blue whales in the Gulf of St. Lawrence, where animals target krill swarms in accessible shallow waters (McQuinn et al. 2016). Data from animals tagged in the St. Lawrence estuary indicate that blue whales use other summer feeding grounds off of Nova Scotia and Newfoundland and also feed sporadically during the winter in the Mid-Atlantic Bight, occasionally venturing to waters along or shoreward of the continental shelf break (Lesage et al. 2017; 2018). Tagging studies show blue whale movements from the Gulf of St. Lawrence to North Carolina, including both on- and off-shelf waters, extending into deeper waters around the New England Seamounts (Lesage et al. 2017; Davis et al. 2020). Acoustic detections of blue whales have occurred in deep waters north of the West Indies and east of the U.S. EEZ, indicating that their southern range limit is unknown (Clark 1995; Nieukirk et al. 2004; Davis et al. 2020).

Recent deployment of passive acoustic devices in the New York Bight yielded detections of blue whales about 20 nm (37 km) southeast of the entrance to New York Harbor during the months of January, February, and March (Muirhead et al. 2018). Blue whale vocalizations have also been detected in the RI/MA WEAs during acoustic surveys (Kraus et al. 2016). However, these vocalizations could have originated at large distances from the receivers, meaning the detections in the RI/MA WEAs do not necessarily mean blue whale presence within these areas. Two sightings of two individual blue whales were observed ~100 km southeast of the Lease Area during the AMAPPS surveys in 2016 (NEFSC and SEFSC 2017) and a blue whale was sighted ~80 km south of the Lease Area during the AMAPPS surveys in 2021 (NEFSC and SEFSC 2022). During three years of monthly surveys in the New York Bight from 2017–2020, Zoidis et al. (2021) reported three sightings of five individual blue whales. Blue whales were not observed during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024).

4.1.1.2 Abundance

The current minimum estimate of the western North Atlantic population, based on photo-identification efforts in the St. Lawrence estuary and the northwestern Gulf of St. Lawrence, is 402 animals (Sears and Calambokidis 2002; Ramp and Sears 2013; Hayes et al. 2020). This work led to a suggestion that between 400–600 individuals may be found in the western North Atlantic (Hayes et al. 2020).

4.1.1.3 Status

The blue whale is listed as Endangered under the ESA and the western North Atlantic stock of blue whales is considered Strategic and Depleted under the MMPA. Human induced threats to blue whales include entanglement in fishing gear, ship-strikes, pollution, and disruptions of pelagic food webs in response to changes in ocean temperatures and circulation processes (Hayes et al. 2020). There is no designated critical habitat for this species within the Offshore Development Area (Hayes et al. 2020).

4.1.2 Fin Whale (Balaenoptera physalus)

Fin whales are the second largest species of baleen whale in the Northern Hemisphere (NMFS 2023b), with a maximum length of about 22.8 m. These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. This species has a distinctive coloration pattern: the dorsal and lateral sides of the body are black or dark brownish-gray, and the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (*Euphausiacea*), small schooling fish (e.g., herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [*Ammodytidae spp*.]), and squid (*Teuthida spp*.) by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010).

Fin whales produce characteristic vocalizations that can be distinguished during PAM surveys (BOEM 2014; Erbe et al. 2017). The most commonly observed calls are the “20-Hz signals,” a short down sweep falling from 30 to 15 Hz over a one-second period. Fin whales can also produce higher frequency sounds up to 310 Hz, and sound levels (SLs) as high as 195 decibels (dB) relative to one microPascal (re 1 µPa) @ 1 m root mean square sound pressure level (SPL_{rms}) have been reported, making it one of the most powerful biological sounds in the ocean (Erbe et al. 2017). Anatomical modeling based on fin whale ear morphology suggests their greatest hearing sensitivity is between 20 Hz and 20 kHz (Cranford and Krysl 2015; Southall et al. 2019).

4.1.2.1 Distribution

Fin whales have a wide distribution and can be found in the Atlantic and Pacific Oceans in both the Northern and Southern Hemisphere (NMFS 2023b). The population is divided by ocean basins; however, these boundaries are arbitrary as they are based on historical whaling patterns rather than biological evidence (NMFS 2024a). Fin whales off the eastern US, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991), which has been called the Western North Atlantic stock.

Fin whales transit between summer feeding grounds in the high latitudes and the wintering, calving, or mating habitats in low latitudes or offshore. However, acoustic records indicate that fin whale populations may be less migratory than other mysticetes whose populations make distinct annual migrations (Watkins et al. 2000). Fin whales typically feed in New England waters on fishes (e.g., sand lance, capelin, herring), krill, copepods, and squid in deeper waters near the edge of the continental shelf (90–180 m) but will migrate towards coastal areas following prey distribution. However, fin whales’ habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are prey for the fin whale (Kenney and Vigness-Raposa 2010). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas remain largely unknown (NMFS 2024a). The Offshore Development Area is flanked by two Biologically Important Areas (BIAs) for feeding for fin whales—the area to the northeast in the Southern Gulf of Maine is considered a BIA year-round, while the area to the southwest off the tip of Long Island is a BIA from March to October (LaBrecque et al. 2015).

Kraus et al. (2016) suggest that, compared to other baleen whale species, fin whales have a high multi-seasonal relative abundance in the MA WEA and RI/MA WEA and surrounding areas. Fin whales were observed during spring and summer of the 2011–2015 Northeast Large Pelagic Survey Collaborative (NLPSC) aerial surveys. This species was observed primarily in the offshore (southern) regions of the MA and RI/MA WEAs during spring and was found closer to shore (northern areas) during the summer months (Kraus et al. 2016). Calves were observed three times and feeding was observed nine times during the Kraus et al. (2016) study. Although fin whales were largely absent from visual surveys in the MA and RI/MA WEAs and in the fall and winter months (Kraus et al. 2016), acoustic data indicated that this species was present in the MA and RI/MA WEAs during all months of the year. Fin whales were acoustically detected in the MA WEA on 87% of study days (889/1,020 days). Acoustic detection data indicated a lack of seasonal trends in fin whale abundance with slightly less detections from April to July (Kraus et al. 2016). Because the detection range for fin whale vocalizations is more than 200 km (108 nautical miles [NM]), detected signals may have originated from areas far outside of the MA and RI/MA WEAs; however, arrival patterns of many fin whale vocalizations indicated that received signals likely originated from within the Kraus et al. (2016) study area.

Following Kraus et al. (2016), aerial surveys focused on marine mammal occurrence have continued in the MA and RI/MA WEA study area (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). There were 32 sightings of 53 individual fin whales between October 2018 and August 2019 (O'Brien et al. 2020), most of which occurred in late spring and early summer (May–June). Fin whale sightings were clustered in the southern and eastern parts of the MA and RI/MA WEAs during those surveys (O'Brien et al. 2020). In the following year of this study, between March and October 2020, fin whales were only observed during summer months within the MA and RI/MA WEAs (O'Brien et al. 2021). In the subsequent study, between September 2020 and October 2021, there were 18 sightings of 27 individual fin whales (O'Brien et al. 2022). Sightings in those surveys occurred during winter, spring, and summer, with most sightings in the summer (O'Brien et al. 2022). Finally, during the most recent surveys by this group (February–August 2022), there were 163 sightings of 212 fin whales (O'Brien et al. 2023). There were sightings in winter, spring, and summer, with most of the sightings in summer. Sightings were clustered in the western portion of the MA and RI/MA WEAs (O'Brien et al. 2023).

Fin whales were observed 113 times (222 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Fin whales were observed during the 2010–2017 Atlantic Marine Assessment Program for Protected Species (AMAPPS) Northeast shipboard surveys conducted during summer and fall, with only one sighting in fall, and they were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest fin whales are most abundant in the area during the summer, followed by spring and then fall, and least abundant, though still present, during winter (Palka et al. 2021).

4.1.2.2 Abundance

The best abundance estimate available for the Western North Atlantic stock is 6,802 individuals based on combined data from 2016 NMFS shipboard and aerial surveys from Florida to the lower Bay of Fundy and Department of Fisheries and Oceans Canada (DFO) aerial surveys from the Bay of Fundy to Newfoundland and Labrador (NMFS 2024a). A population trend analysis does not currently exist for this stock because of insufficient data; however, based on photographic identification, the gross annual reproduction rate is 8% with a mean calving interval of 2.7 years (Agler et al. 1993; NMFS 2024a).

4.1.2.3 Status

Fin whales are listed as endangered under the ESA (NMFS 2024a) and the MA ESA (MassWildlife 2024). This stock is listed as strategic under the MMPA due to its endangered status (NMFS 2024a). Potential Biological Removal (PBR) for the western North Atlantic fin whale is 11. PBR is defined as the product of minimum population size, one-half the maximum net productivity rate and recovery factor for endangered, depleted, threatened, or stocks of unknown status relative to the optimal sustainable population (OSP) (NMFS 2024a). Annual human-caused mortality and serious injury for the period between 2017 and 2021 was estimated to be 2.05 per year (NMFS 2024a). This estimate includes incidental fishery interactions (i.e., bycatch/entanglement) and vessel collisions, but does not include other threats to fin whales such as contaminants found within their habitat and potential climate-related shifts in distribution of prey species, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.1.3 Gray Whale (Eschrichtius robustus)

Gray whales have a mottled gray body and no dorsal fin, and can grow to about 15 m (49 feet) in length (NMFS 2024c). The gray whale historically existed in the North Atlantic, where it is believed to have been eradicated in the 1700s (Lindquist 2000). In May 2010, a single gray whale was sighted and photographed off the Israeli Mediterranean shore, and then later in Spanish Mediterranean waters; this was the first recorded occurrence of a gray whale in the North Atlantic since the 1700s, and the first recorded occurrence in the Mediterranean Sea (Scheinin et al. 2011). Scheinin et al. (2011) thought it most likely that it was a vagrant individual from the population of gray whales found in the eastern North Pacific. On March 1, 2024, a single gray whale was observed swimming south of Nantucket during a New England Aquarium aerial survey (NEAq 2024a). It is presumed that this animal migrated from the North Pacific into the North Atlantic through the Northwest Passage, which has regularly been ice-free during the summer in recent years due to rising global temperatures, and is likely the same whale observed off Florida in December 2023 (NEAq 2024b).

4.1.3.1 Distribution

Gray whales were once common throughout the Northern Hemisphere but are now only regularly found in the North Pacific (NMFS 2024c). There are two stocks of gray whales in the North Pacific – the Eastern North Pacific (ENP) distinct population segment (DPS) and the ESA-listed endangered Western North Pacific DPS (NMFS 2024c). During summer and fall, most whales in the ENP stock feed in the Chukchi, Beaufort and northwestern Bering Seas (Carretta et al. 2021). In the western North Pacific (WNP), gray whales feed during summer and fall in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea (Carretta et al. 2021). Genetic evidence suggests that these stocks are distinct (Carretta et al. 2021). However, the distinction between these two populations has been recently debated based on evidence that whales from the western feeding area also travel to breeding areas in the eastern North Pacific (Weller et al. 2012; 2013; Mate et al. 2015). It is possible that any extralimital whale observed in the North Atlantic could belong to either the ESA-listed endangered Western North Pacific DPS or the delisted Eastern North Pacific DPS.

4.1.3.2 Abundance

The best available abundance estimate for the WNP stock is 290 individuals and the best available abundance for the ENP stock is 26,960 individuals (Carretta et al. 2021).

4.1.3.3 Status

The WNP gray whale stock is listed as endangered under the ESA and the ENP gray whale stock was delisted in 1994.

4.1.4 Humpback Whale (Megaptera novaeangliae)

Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. Female humpback whales are larger than males and can reach lengths of up to 18 m (NMFS 2023c). These baleen whales feed on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales use unique behaviors, including bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NMFS 1991).

During migration and breeding seasons, male humpback whales are often recorded producing vocalizations arranged into repetitive sequences termed “songs” that can last for hours or even days. These songs have been well studied in the literature to document changes over time and geographic differences. Generally, the frequencies produced during these songs range from 20 Hz to over 24 kHz. Most of the energy is focused between 50 and 1,000 Hz and reported SLs range from 151 to 189 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Other calls produced by humpbacks, both male and female, include pulses, moans, and grunts used for foraging and communication. These calls are lower frequency (under 2 kHz) with SLs ranging from 162 to 190 dB re 1 µPa @ 1 m SPL_{rms} (Thompson et al. 1986; Erbe et al. 2017). Anatomical modeling based on humpback whale ear morphology indicates that their best hearing sensitivity is between 18 Hz and 15 kHz (Ketten et al. 2014; Southall et al. 2019).

4.1.4.1 Distribution

The humpback whale can be found worldwide in all major oceans from the equator to sub-polar latitudes and have annual migrations of thousands of miles between breeding and feeding grounds (NMFS 2023c). In summer, humpbacks are found at higher latitudes feeding in the Gulf of Maine and Gulf of Alaska. During the winter months, humpbacks migrate to calving grounds in subtropical or tropical waters, such as the Dominican Republic in the Atlantic and Hawaiian Islands in the Pacific (Hayes et al. 2020). Humpback whales from the North Atlantic feed, mate, and calve in the West Indies (Hayes et al. 2020). In the summer, humpback whales in the western North Atlantic are typically observed in the Gulf of Maine and along the Scotian Shelf; there have also been numerous winter sightings in the southeastern US (Hayes et al. 2020). Feeding behavior has also been observed in New England off Long Island, New York, and NMFS survey data suggests a potential increase in humpback whale abundance off New Jersey and New York (Hayes et al. 2020).

Kraus et al. (2016) observed humpback whales in the MA and RI/MA WEAs, and surrounding areas during all seasons of the 2011–2015 NLPSC aerial surveys. Humpback whales were observed most often during the spring and summer months, with a peak from April to June. Calves were observed 10 times and feeding was observed 10 times during the Kraus et al. (2016) study. That study also observed one instance of courtship behavior. Although humpback whales were only rarely seen during fall and winter surveys, acoustic data indicate that this species may be present within the MA WEA year-round, with the highest rates of acoustic detections in winter and spring (Kraus et al. 2016). Humpback whales were acoustically detected in the MA WEA on 56% of acoustic survey days (566/1,020 days). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. The mean detection range for humpback whales using PAM was 30–36 km (16-19 NM.), with a mean radius of 36 km (19 NM) for the PAM system. Kraus et al. (2016) estimated that 63% of acoustic detections of humpback whales represented whales within their study area.

Following Kraus et al. (2016), aerial surveys focused on marine mammal occurrence have continued in the MA and RI/MA WEA study area (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). Trends similar to those observed by Kraus et al. (2016) were seen during the October 2018 and August 2019 study (O'Brien et al. 2020). There was a total of 30 humpback whale sightings of 32 individuals observed in the MA and RI/MA WEAs (O'Brien et al. 2020). Humpback whales were present during all seasons with peak sightings and the greatest relative abundance in spring and summer. The majority of sightings were on the eastern side of the MA and RI/MA WEAs, regardless of time of year (O'Brien et al. 2020). In the following year of this study, from March to October 2020, humpback whales were the most frequently sighted cetacean, although not the most abundant, accounting for 22% of all sightings (O'Brien et al. 2021). Over the survey period, there were 22 sightings of 44 individual humpback whales. During the 2020 survey, sightings were also concentrated more on the eastern side of the MA and RI/MA WEAs, and just outside the WEAs in the Nantucket Shoals area. In the subsequent study, from September 2020 to October 2021, there were 66 sightings of 97 individuals observed (O'Brien et al. 2022). Humpback whales were sighted across the entire study area; however, seasonal distribution patterns were observed. During fall seasons, humpback whales were observed most prevalently in Nantucket Shoals; during spring and summer months, humpback whales were spread more evenly across the MA and RI/MA WEAs (O'Brien et al. 2022). Finally, during the most recent surveys by this group (February–August 2022), there were 137 sightings of 197 fin whales (O'Brien et al. 2023). There were sightings in all months during spring and summer. Sightings occurred throughout the MA and RI/MA WEAs but were clustered more to the north in the summer and to the south in the spring (O'Brien et al. 2023) There were 33 sightings of bubble feeding humpback whales during May–August and mother–calf pairs were seen on six occasions.

Humpback whales were observed 183 times (398 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Humpback whales were observed only in the summer during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall, and were observed during all seasons of the 2010–2017 AMAPPS Northeast aerial surveys, but most often in summer and fall (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest humpback whales are most abundant in the area during the summer, followed by spring and then fall, and least abundant, though still present, during winter (Palka et al. 2021).

4.1.4.2 Abundance

The best available abundance estimate of the Gulf of Maine stock is 1,396 individuals, derived from modeled sighting histories constructed using photo-identification data collected through October 2016 (Hayes et al. 2020). Available data indicate that this stock is characterized by a positive population trend, with an estimated increase in abundance of 2.8% per year (Hayes et al. 2020).

4.1.4.3 Status

Humpback whales are considered endangered under the MA ESA (MassWildlife 2024). However, NMFS revised the listing status for humpback whales under the ESA in 2016 (81 FR 62260 2016). Globally, there are 14 DPSs recognized for humpback whales, four of which are listed as endangered. The Gulf of Maine stock (formerly known as the Western North Atlantic stock) which occurs in the Offshore Development Area is considered non-strategic under the MMPA and does not coincide with any ESA-listed DPS (Hayes et al. 2020). This stock is considered non-strategic because the detected level of US fishery-caused mortality and serious injury derived from the available records does not exceed the calculated PBR of 22, with a set recovery factor at 0.5 (Hayes et al. 2020). Because the observed mortality is estimated to be only 20% of all mortality, total annual mortality may be 60-70 animals in this stock (Hayes et al. 2020). If anthropogenic causes are responsible for as little as 31% of potential total mortality, this stock could be over its PBR. While detected mortalities yield an estimated minimum fraction anthropogenic mortality of 0.85, additional research is being done before apportioning mortality to anthropogenic versus natural causes for undetected mortalities and making a potential change to the MMPA status of this stock.

An Unusual Mortality Event (UME) was declared for this species in January 2016, which as of March 2024, has resulted in 214 mortalities, with 42 of those occurring off Massachusetts (NMFS 2024f). Stranding investigations have concluded that 40% of the stranded humpback whales show signs of interaction with vessels or entanglement in commercial fishing gear (NMFS 2024f). A BIA for humpback whales for feeding has been designated northeast of the Offshore Development Area in the Gulf of Maine, Stellwagen Bank, and the Great South Channel from March through December (LaBrecque et al. 2015). Major threats to humpback whales include vessel strikes, entanglement, and climate-related shifts in prey distribution (Hayes et al. 2020).

4.1.5 Minke Whale (Balaenoptera acutorostrata)

Minke whales are a baleen whale species reaching 10 m in length. The minke whale is common and widely distributed within the US Atlantic EEZ and is the third most abundant great whale (any of the larger marine mammals of the order Cetacea) in the EEZ (CeTAP 1982). A prominent morphological feature of the minke whale is the large, pointed median ridge on top of the rostrum. The body is dark gray to black with a pale belly, and frequently shows pale areas on the sides that may extend up onto the back. The flippers are smooth and taper to a point, and the middle third of each flipper has a conspicuous bright white band that can be distinguished during visual surveys (Kenney and Vigness-Raposa 2010). Its diet is comprised primarily of crustaceans, schooling fish, and copepods. Minke whales generally travel in small groups (one to three individuals), but larger groups have been observed on feeding grounds (NMFS 2023h).

In the North Atlantic, minke whales commonly produce pulse trains lasting 10 –70 seconds with a frequency range between 10 and 800 Hz. SLs for this call type have been reported between 159 and 176 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Some minke whales also produce a unique “boing” sound which is a train of rapid pulses often described as an initial pulse followed by an undulating tonal (Rankin and Barlow 2005; Erbe et al. 2017). The “boing” ranges from one to five kHz with an SLs of approximately 150 dB re 1 µPa @ 1 m SPL_{rms} (Rankin and Barlow 2005; Erbe et al. 2017). Auditory sensitivity for this species based on anatomical modeling of minke whale ear morphology is best between 10 Hz and 34 kHz (Ketten et al. 2014; Southall et al. 2019).

4.1.5.1 Distribution

Minke whales prefer the colder waters in northern and southern latitudes, but they can be found in every ocean in the world. Available data suggest that minke whales are distributed in shallower waters along the continental shelf between the spring and fall and are located in deeper oceanic waters between the winter and spring (NMFS 2024a). They are most abundant in New England waters during spring through fall (NMFS 2024a). Acoustic detections show that minke whales migrate sound in mid-October to early November and return from wintering grounds starting in March through early April (Risch et al. 2014b).

Kraus et al. (2016) observed minke whales in the MA and RI/MA WEAs and surrounding areas primarily from May to June during the 2011–2015 NLPSC aerial survey. This species demonstrated a distinct seasonal habitat usage pattern that was consistent throughout the study. Minke whales were not observed between October and February, but acoustic data indicate the presence of this species in the winter months. Calves were observed twice, and feeding was also observed twice during the Kraus et al. (2016) study. Minke whales were acoustically detected in the MA WEA on 28% of project days (291/1,020 days). Minke whale acoustic presence data also exhibited a distinct seasonal pattern; acoustic presence was lowest in the months of December and January, steadily increased beginning in February, peaked in April, and exhibited a gradual decrease throughout the summer months (Kraus et al. 2016). Acoustic detection range for this species was small enough that over 99% of detections were limited to within the Kraus et al. (2016) study area.

Following Kraus et al. (2016), aerial surveys focused on marine mammal occurrence have continued in the MA and RI/MA WEA study area (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). There were 98 sightings of 115 individual minke whales between October 2018 and August 2019 (O'Brien et al. 2020). Minke whales were the most frequently sighted cetacean at 28% of on-effort sightings. The majority of these sightings occurred during the spring and summer (mostly during April and June). Only two sightings occurred during the winter, and none occurred during the fall. In the following year of this study, between March and October 2020, minke whales were sighted during all months within the MA and RI/MA WEAs except March and October (O'Brien et al. 2021). In the subsequent study, between September 2020 and October 2021, there were 24 sightings of 24 individuals observed (O'Brien et al. 2022). These sightings occurred during all seasons, and the majority were in the Nantucket Shoals. Finally, during the most recent surveys by this group (February–August 2022), there were 96 sightings of 100 individual minke whales, sighted in the spring and summer (O'Brien et al. 2023).

Minke whales were observed 141 times (179 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Minke whales were observed during the 2010–2017 Northeast shipboard surveys conducted during summer and fall, and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest minke whales are most abundant in the area during the spring, followed by summer and then fall, and then winter (Palka et al. 2021).

4.1.5.2 Abundance

The best available population estimate for the Canadian East Coast stock, which occurs in the Offshore Development Area, is 21,968 minke whales, derived from surveys conducted by NMFS and

DFO Canada between Labrador and central Virginia (NMFS 2024a). There are no current population trends or net productivity rates for this species due to insufficient data.

4.1.5.3 Status

Minke whales are not listed under the ESA or classified as strategic under the MMPA (NMFS 2024a). The estimated annual human-caused mortality and serious injury from 2017 to 2021 was 9.40 per year attributed to fishery interactions, vessel strikes, and non-fishery entanglement in both the US and Canada (NMFS 2024a). A UME was declared for this species in January 2017, which is ongoing (NMFS 2024e). As of March 2024, a total of 164 strandings have been reported, with 57 of those occurring off Massachusetts (NMFS 2024e). The PBR for this stock is estimated to be 170 (NMFS 2024a). A BIA for minke whales for feeding has been designated east of the Offshore Development Area from March through November (LaBrecque et al. 2015). Minke whales may also be vulnerable to climate-related changes in prey distribution, although the extent of this effect on minke whales remains uncertain (NMFS 2024a).

4.1.6 North Atlantic Right Whale (Eubalaena glacialis)

NARWs are among the rarest of all marine mammal species in the Atlantic Ocean. Adults can be as large as 16 m in length (NMFS 2023j). They have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities, and they have a distinctive v-shaped blow. They are slow-moving grazers that feed on dense concentrations of prey (mostly copepods and other zooplankton) at or below the water's surface, as well as at depth (NMFS 2023j). Research suggests that NARWs must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are a primary characteristic of the spring, summer, and fall NARW habitats (Kenney et al. 1995). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008).

NARW vocalizations most frequently observed during PAM studies include upsweeps rising from 30 to 450 Hz, often referred to as "upcalls," and broadband (30 to 8,400 Hz) pulses, or "gunshots," with SLs between 172 and 187 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). However, recent studies have shown that mother-calf pairs reduce the amplitude of their calls in the calving grounds, possibly to avoid detection by predators (Parks et al. 2019). Modeling conducted using right whale ear morphology suggest that the best hearing sensitivity for this species is between 16 Hz and 25 kHz (Ketten et al. 2014; Southall et al. 2019).

4.1.6.1 Distribution

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds (Whitt et al. 2013). The Western North Atlantic stock of NARWs ranges primarily from calving grounds in coastal waters of the southeastern US to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (NMFS 2024a). These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the US east coast to their calving grounds in the waters of the southeastern US (Kenney and Vigness-Raposa 2010).

NARWs are considered to be comprised of two separate stocks: Eastern and Western Atlantic stocks. The Eastern North Atlantic stock was largely extirpated by historical whaling (Aguilar 1986). NARWs in US waters belong to the Western North Atlantic stock. Previously, seven areas were identified where NARWs were known to congregate seasonally: the coastal waters of the southeastern US, the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Hayes et al. 2018). However, since 2010, NARWs have been declining in and around once key habitats in the Gulf of Maine and the Bay of Fundy (Davies et al. 2015; Davis et al. 2017), while sightings have increased in other areas including Cape Cod Bay, Massachusetts Bay, the Mid-Atlantic Bight, and the Gulf of St. Lawrence (Whitt et al. 2013; Davis et al. 2017; Mayo et al. 2018; Davies and Brillant 2019; Ganley et al. 2019; Charif et al. 2020). An eight-year analysis of NARW sightings within southern New England (SNE) showed that the NARW distribution has been shifting (Quintana-Rizzo et al. 2021). Sightings of NARWs were recorded in the SNE study area (shores of Martha's Vineyard and Nantucket to and covering all the offshore wind lease sites of Massachusetts and Rhode Island) in almost all months of the year, with the highest sighting rates between December and May, when close to a quarter of the population may be present at any given time (Quintana-Rizzo et al. 2021). Recently, NARWs have been seen both within the MA and RI/MA WEAs and over the Nantucket Shoals in every season (O'Brien et al. 2023).

The winter distribution of much of the NARW population is largely unknown. Some evidence provided through acoustic monitoring suggests that not all individuals of the population participate in annual migrations, with a continuous presence of NARWs occupying their entire habitat range throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). Acoustic monitoring shows year-round presence on the Scotian Shelf, in the Gulf of Maine, and off southern New England, New York, New Jersey, and Virginia (NMFS 2024a). These data also recognize changes in population distribution throughout the NARW habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the NARW distribution cycle (Davis et al. 2017). A climate-driven shift in the Gulf of Maine/western Scotian Shelf region occurred in 2010 and impacted the foraging environment, habitat use, and demography of the NARW population (Meyer-Gutbrod et al. 2021). In 2010, the number of NARWs returning to the traditional summertime foraging grounds in the eastern Gulf of Maine/Bay of Fundy region began to decline rapidly (Davies and Brillant 2019; Davies et al. 2019; Record et al. 2019). Despite considerable survey effort, the location of most of the population during the 2010-2014 foraging seasons is largely unknown; however, sporadic sightings and acoustic detections in Canadian waters suggest a dispersed distribution (Davies et al. 2019) and a significant increase in the presence of whales in the southern Gulf of St. Lawrence beginning in 2015 (Simard et al. 2019).

Kraus et al. (2016) observed NARWs in the MA and RI/MA WEAs and surrounding waters in winter and spring during the 2011–2015 NLPSC aerial survey and observed 11 instances of courtship behavior. The greatest SPUE in the MA and RI/MA WEAs was in March. Seventy-seven unique individual NARWs were observed in the MA and RI/MA WEAs over the duration of the NLPSC surveys (Kraus et al. 2016). No calves were observed. Kraus et al. (2016) acoustically detected NARWs with PAM within the MA WEA on 43% of project days (443/1,020 days) and during all months of the year. Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. NARWs exhibited notable seasonal variability in acoustic presence, with maximum occurrence in the winter and spring (January through March), and minimum occurrence in summer (July, August, and September). The mean detection range for NARWs using PAM was 15–24 km (8-13 NM), with a mean radius of 21 km (11 NM) for the PAM system within the study area.

Following Kraus et al. (2016), aerial surveys focused on marine mammal occurrence have continued in the MA and RI/MA WEA study area (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). There were 112 sightings of 164 individual NARWs during directed surveys between October 2018 and August 2019 (O'Brien et al. 2020). In contrast with the aerial surveys conducted by Kraus et al. (2016), NARWs were observed in the MA and RI/MA WEAs during every season, in nine of eleven months. December through February had the highest number of sightings, with a peak in January. NARWs were recorded predominantly on the eastern side of the survey area. The distribution was observed to change seasonally with NARWs moving north from the southern portion of Nantucket Shoals in winter to an area 18.52 km (10 NM) south of Nantucket in April. The aggregation was then observed to move south again back to Nantucket Shoals in late July persisting in the area until the end of the survey period in August (O'Brien et al. 2020). In the following survey year, between March and October 2020, there were 10 sightings of 15 individual NARWs (O'Brien et al. 2021). Sighting rates were higher in the fall than summer, and the feeding aggregation observed in previous years during the summer was absent (O'Brien et al. 2021). NARWs were only sighted on the eastern side of the study area, over Nantucket Shoals. In the subsequent study, between September 2020 and October 2021, right whales were the mostly commonly sighted whale, with 90 sightings of 169 NARWs (O'Brien et al. 2022). NARWs were sighted in all seasons. During summer and fall, all but one sighting of NARWs were over the Nantucket Shoals. In winter, the majority of NARW sightings were still over the Nantucket Shoals, but they were also sighted within the RI and MA WEAs and near Martha’s Vineyard. During spring months, there were no NARW sightings over the Nantucket Shoals; all sightings were aggregated in or near the MA and RI/MA WEAs (O'Brien et al. 2022). Finally, during the most recent surveys by this group (February–August 2022), there were 22 NARW sightings of 31 individuals. During this survey, NARWs were sighted both in the RI and MA WEAs and over the Nantucket Shoals in every season, with most sightings over the Nantucket Shoals (O'Brien et al. 2023). NARWs were observed 16 times (23 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024).

Based on the available information, sightings of this species in the Offshore Development Area are possible at any time of year.

4.1.6.2 Abundance

The Western North Atlantic population size was estimated to be 340 individuals in the most recent SAR (NMFS 2024a), which used data from the photo-identification database maintained by the NEAq that were available at the end of August 2022. However, the Right Whale Consortium 2023 Report Card estimates the NARW population to be 356 individuals in 2022 (Pettis and Hamilton 2024). A population trend analysis conducted on the abundance estimates from 1990 to 2011 suggest an increase at about 2.8% per year from an initial abundance estimate of 270 individuals in 1998 to 481 in 2011, but there was a 100% chance the abundance declined from 2011 to 2021 when the final estimate was 340 individuals (NMFS 2024a). Based on the abundance estimates between 2011 and 2021, there was an overall abundance decline of 29.3% (derived from 2011 and 2021 median point estimates) (NMFS 2024a). Modeling conducted by Pace (2021) showed a decline in annual abundance after 2011 (NMFS 2024a). Highly variable data exist regarding the productivity of this stock. Over time, there have been periodic swings of per capita birth rates (NMFS 2024a). Net productivity rates do not exist as the Western North Atlantic stock lacks any definitive population trend (NMFS 2024a).

4.1.6.3 Status

The NARW is listed as endangered under the ESA (NMFS 2024a) and MA ESA (MassWildlife 2024). NARWs are considered to be the most critically endangered large whales in the world (NMFS 2024a). The average annual human-related mortality/injury rate exceeds that of the calculated PBR of 0.7, classifying this population as strategic and depleted under the MMPA (NMFS 2024a). Estimated human-caused mortality and serious injury between 2017 and 2021 was 7.1 whales per year (NMFS 2024a). Using a hierarchical Bayesian, state-space model (Pace et al. 2021) the estimated rate of total mortality is 27.2 animals per year, or 136 animals total, for the period of 2016–2020. That annual rate of total mortality is 3.4 times higher than the 8.1 detected mortality and serious injury value reported for the same period in the previous stock assessment report (NMFS 2024a). To apportion the estimated total NARW mortality by cause, the proportion of observed mortalities and serious injuries from entanglement compared to those from vessel collision for the period of 2017–2021 was used (NMFS 2024a). During this period, 65% of the observed mortalities and serious injuries were the result of entanglement and 35% were from vessel collisions (NMFS 2024a). A UME was declared for this species beginning in 2017, which is ongoing (NMFS 2024b). As of March 2024, a total of 39 mortalities and 33 serious injuries have been reported.

To protect this species from ship strikes, NMFS designated Seasonal Management Areas (SMAs) in US waters in 2008 (NMFS 2008). All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 18.4 km/hour (10 NM/hour) or less within these areas during specific time periods. The Block Island Sound SMA overlaps with the southern portion of the MA WEA and is active between November 1 and April 30 each year. The Great South Channel SMA lies to the northeast of the MA WEA and is active April 1 to July 31. In addition, the rule provides for the establishment of Dynamic Management Areas (DMAs) when and where NARWs are sighted outside SMAs. DMAs are generally in effect for two weeks and the 18.4 km/hour (10 knots) or less speed restriction is voluntary.

NMFS has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region and the southeast calving grounds from North Carolina to Florida (81 FR 4838 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009). The Offshore Development Area is encompassed by a NARW BIA for migration from March to April and from November to December (LaBrecque et al. 2015). The NARW BIA for migration includes the MA and RI/MA WEAs and beyond to the continental slope, extending northward to offshore of Provincetown, MA and southward to halfway down the Florida coast (LaBrecque et al. 2015).

4.1.7 Sei Whale (Balaenoptera borealis)

Sei whales are a baleen whale that can reach lengths of about 12–18 m (NMFS 2023e). This species has a long, sleek body that is dark bluish gray to black in color and pale underneath (NMFS 2023e). Their diet is comprised primarily of plankton, schooling fish, and cephalopods. Sei whales generally travel in small groups of two to five individuals (NMFS 2023e).

Although uncertainties still exist with distinguishing sei whale vocalizations during PAM surveys, they are known to produce short duration (0.7 to 2.2 seconds) upsweeps and downsweeps between 20 and

600 Hz. SLs for these calls can range from 147 to 183 dB re 1 μPa @ 1 m SPL_{rms} (Erbe et al. 2017). No auditory sensitivity data are available for this species (Southall et al. 2019).

4.1.7.1 Distribution

Sei whales occur in all the world's oceans and migrate between feeding grounds in temperate and sub-polar regions to wintering grounds in lower latitudes (Kenney and Vigness-Raposa 2010; NMFS 2023e). In the western North Atlantic, most of the population is concentrated in northerly waters along the Scotian Shelf. Sei whales are observed in the spring and summer, using the northern portions of the US Atlantic EEZ as feeding grounds, including the Gulf of Maine and Georges Bank (NMFS 2024a). The highest concentration is observed during the spring along the eastern margin of Georges Bank and in the Northeast Channel area along the southwestern edge of Georges Bank. PAM conducted along the Atlantic Continental Shelf and Slope in 2004-2014 detected sei whales calls from south of Cape Hatteras to the Davis Strait with evidence of distinct seasonal and geographic patterns. Davis et al. (2020) detected peak call occurrence in northern latitudes during summer indicating feeding grounds ranging from SNE through the Scotian Shelf. Sei whales were recorded in the southeast on Blake's Plateau in the winter months, but only on the offshore recorders indicating a more pelagic distribution in this region. Persistent year-round detections in SNE and the New York Bight highlight this as an important region for the species (NMFS 2024a). In general, sei whales are observed offshore with periodic incursions into more shallow waters for foraging (NMFS 2024a).

Kraus et al. (2016) observed sei whales in the MA and RI/MA WEAs and surrounding areas only between the months of March and June during the 2011–2015 NLPSC aerial survey. The number of sei whale observations was less than half that of other baleen whale species in the two seasons in which sei whales were observed (spring and summer). This species demonstrated a distinct seasonal habitat use pattern that was consistent throughout the study. Calves were observed three times and feeding was observed four times during the Kraus et al. (2016) study.

Following Kraus et al. (2016), aerial surveys focused on marine mammal occurrence have continued in the MA and RI/MA WEA study area (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). There were 28 sightings of 55 individual sei whales observed between October 2018 and August 2019, all of which occurred in May and June (O'Brien et al. 2020). Observations of sei whales were made in the southern portion of the survey area outside the MA and RI/MA WEAs (O'Brien et al. 2020). No sei whales were observed within the MA and RI/MA WEAs in the following year of this study (O'Brien et al. 2021). In the subsequent study, between September 2020 and October 2021, there was one sighting of one individual sei whale (O'Brien et al. 2022). Finally, during the most recent surveys by this group (February–August 2022), there were three sightings of three individual sei whales (O'Brien et al. 2023). Based on the observed sightings from these as well as the Kraus et al. (2016) aerial surveys, sei whales are expected to be present in much lower numbers than the other baleen whales.

Sei whales were observed 25 times (43 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Sei whales were observed only in summer during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and they were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys, but most frequently in spring (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest sei whales are most abundant in the area during the spring, followed by summer, and then fall, then winter (Palka et al. 2021).

4.1.7.2 Abundance

Prior to 1999, sei whales in the Western North Atlantic were considered a single stock. Following the suggestion of the Scientific Committee of the IWC, two separate stocks were identified for this species: a Nova Scotia stock and a Labrador Sea stock. Only the Nova Scotia stock can be found in US waters, and the current abundance estimate for this stock is 6,292 derived from recent surveys conducted between Halifax, Nova Scotia and Florida (NMFS 2024a). Population trends are not available for this stock because of insufficient data (NMFS 2024a).

4.1.7.3 Status

Sei whales are listed as endangered under the ESA (NMFS 2024a) and MA ESA (MassWildLife 2024). This stock is listed as depleted under the MMPA and is considered strategic due to its endangered status (NMFS 2024a). Annual human-caused mortality and serious injury from 2017 to 2021 was estimated to be 0.6 per year (NMFS 2024a). The PBR for this stock is 6.2 (NMFS 2024a). Like fin whales, major threats to sei whales include fishery interactions, vessel collisions, contaminants, climate-related shifts in prey species, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a). There are no critical habitat areas designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs east of the Offshore Development Area from May through November (LaBrecque et al. 2015).

4.2 Odontocetes

4.2.1 Sperm Whale (Physeter macrocephalus)

The sperm whale is the largest of all toothed whales; males can reach 16 m in length and weigh over 45 tons, and females can attain lengths of up to 11 m and weigh over 15 tons (Whitehead 2018). Sperm whales have extremely large heads, which account for 25–35% of the total length of the animal. This species tends to be uniformly dark gray in color, though lighter spots may be present on the ventral surface. Sperm whales typically dive to depths of 600 m for about 45 minutes in search of their prey, which mainly consist of mesopelagic fish and squid; some dives can be deeper (over 1,000 m) and last longer (Whitehead 2018). Sperm whales form stable social groups and exhibit a geographic social structure; females and juveniles form mixed groups and primarily reside in tropical and subtropical waters, whereas males are more solitary and wide-ranging and occur at higher latitudes (Whitehead 2003).

Unlike mysticete whales that produce various types of calls used solely for communication, sperm whales produce clicks that are used for echolocation and foraging as well as communication (Erbe et al. 2017). Sperm whale clicks have been grouped into five classes based on the click rate, or number of clicks per second; these include “squeals,” “creaks,” “usual clicks,” “slow clicks,” and “codas.” In general, these clicks are broadband sounds ranging from 100 Hz to 30 kHz with peak energy centered around 15 kHz. Depending on the class, SLs for sperm whale calls range between approximately 166 and 236 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Hearing sensitivity data for this species are currently unavailable (Southall et al. 2019).

4.2.1.1 Distribution

Sperm whales can be found throughout the world's oceans. They can be found near the edge of the ice pack in both hemispheres and are also common along the equator. The North Atlantic stock is distributed mainly along the continental shelf-edge, over the continental slope, and mid-ocean regions (NMFS 2024a). In the winter, sperm whales are observed east and northeast of Cape Hatteras. In the spring, sperm whales are more widely distributed throughout the Mid-Atlantic Bight and southern portions of George's Bank (NMFS 2024a). In the summer, sperm whale distribution is similar to the spring, but they are more widespread in Georges Bank and the northeast Channel region and are also observed inshore of the 100-m isobath south of New England (NMFS 2024a). Sperm whales occur on the continental shelf in areas south of New England in relatively high numbers in the fall and remain present along the continental shelf edge (NMFS 2024a).

Kraus et al. (2016) observed sperm whales four times in the MA and RI/MA WEAs and surrounding areas in the summer and fall during the 2011–2015 NLPSC aerial survey. Sperm whales, traveling individually or in groups of three or four, were observed three times in August and September of 2012, and once in June of 2015 (Kraus et al. 2016). Effort-weighted average sighting rates could not be calculated. The frequency of sperm whale clicks exceeded the maximum frequency of PAM equipment used in the Kraus et al. (2016) study, so no acoustic data are available for this species from that study. During more recent aerial surveys conducted within the MA and RI/MA WEAs, two groups of sperm whales were observed in June and July of 2019 (O'Brien et al. 2020). On June 12, a group of four whales was sighted, and a group of two whales was sighted on July 15. Both groups were observed in relatively shallow water close to shore, with the June 12 sighting 18.5 km (10 NM) south of Nantucket Island and the July 15 sighting 24 km (13 NM) southwest of the island. Both groups were observed diving and milling at the surface (O'Brien et al. 2020). In subsequent studies by this group – March–October 2020 (O'Brien et al. 2021), November 2020–October 2021 (O'Brien et al. 2022), and February–August 2022 (O'Brien et al. 2023) – no sperm whales were observed.

Sperm whales were not observed during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Sperm whales were observed during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall, and were observed in all seasons except winter during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest sperm whales are most abundant in the area during the summer, though much less abundant than the mysticete whales, and at very low abundances the rest of the year (Palka et al. 2021).

4.2.1.2 Abundance

The IWC recognizes only one stock of sperm whales for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. The best available abundance estimate based on 2021 surveys conducted between the lower Bay of Fundy and central Florida is 5,895 individuals (NMFS 2024a). No population trend analysis is available for this stock.

4.2.1.3 Status

Sperm whales are listed as endangered under the ESA (NMFS 2024a). The western North Atlantic stock is considered strategic under the MMPA due to its listing as endangered under the ESA (NMFS 2024a). Annual human-caused mortality and serious injury from 2017 to 2021 was estimated to be 0.2 per year (NMFS 2024a). The PBR for this stock is 9.28 (NMFS 2024a). Because the total estimated human-caused mortality and serious injury is <10% of this calculated PBR, it is considered insignificant (NMFS 2024a). Other threats to sperm whales include contaminants, anthropogenic sound, climate-related shifts in prey species, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a). There is no designated critical habitat for this population in the Offshore Development Area.

4.2.2 Atlantic Spotted Dolphin (Stenella frontalis)

There are two species of spotted dolphins in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*Stenella attenuata*) (Perrin et al. 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and the other is smaller in size with less spots and occurs in the Atlantic Ocean (Fulling and Fertl 2003; Mullin and Fulling 2003; Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Hayes et al. 2021). Atlantic spotted dolphins in the western Atlantic belong to the Western North Atlantic stock (Hayes et al. 2021). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). They form groups of varying sizes, usually less than 50 individuals, but can be seen travelling in groups of more than 200. In shallower waters, group size is typically five to 15 individuals.

Atlantic spotted dolphins are in the mid-frequency functional hearing group (Southall et al. 2007b). They have an auditory bandwidth of 150 Hz to 160 kHz with vocalizations typically ranging from 100 Hz to 130 kHz (DoN 2008). Because calls produced by many delphinid species are highly variable and overlap in frequency characteristics, they are challenging to identify to individual species during acoustic studies (Oswald et al. 2007).

4.2.2.1 Distribution

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 10 to 200 m (33 to 650 ft) deep to slope waters greater than 500 m (1,640 ft) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). They occur in the US Atlantic waters year-round, ranging from the Mid-Atlantic south through the Caribbean and the Gulf of Mexico (Hayes et al. 2021). This species inhabits inshore waters and along the continental shelf edge and slope, with sightings concentrated north of Cape Hatteras.

Kraus et al (2016) suggest that Atlantic spotted dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for this species could not be calculated because most small cetaceans sighted during the study could not be identified to species due to their size. However, during a 2020 G&G survey in or adjacent to the Offshore Development Area, there were observations of Atlantic spotted dolphins during summer months (Vineyard-Wind 2020). It is possible that the NLPSC surveys may have underestimated the abundance of Atlantic spotted dolphins, as the study was designed for large cetaceans.

4.2.2.2 Abundance

The best available abundance estimate for Atlantic spotted dolphins is 31,506 from 2021 surveys from Central Florida to the Lower Bay of Fundy (NMFS 2024a). Distinction between the two Atlantic spotted dolphin ecotypes has not regularly been made during surveys (Hayes et al. 2020).

4.2.2.3 Status

The Atlantic spotted dolphin is not listed under the ESA and is not considered strategic under the MMPA. There have been no recent UMEs declared for the Atlantic spotted dolphin. No fishing-related mortality of spotted dolphin was reported for 1998 through 2003 (Yeung 1999, 2001; Garrison 2003; Garrison and Richards 2004). From 2007 through 2011, the estimated mean annual fishery-related mortality and serious injury for this species was 42 Atlantic spotted dolphins (Hayes et al. 2017). More recent observer data are not available. The commercial fisheries that interact or potentially interact with the Atlantic spotted dolphin are the pelagic longline fishery and the shrimp trawl fishery (Hayes et al. 2017). From 2013 – 2017, 21 Atlantic spotted dolphins were reported stranded between North Carolina and Florida (Hayes et al. 2020). It could not be determined whether there was evidence of human interaction for nine of these strandings, and for 12 dolphins, no evidence of human interaction was detected (Hayes et al. 2020). However, stranding data likely underestimates the extent of fishery-related mortality (and serious injury) because not all of the marine mammals that die or are seriously injured are reported.

4.2.3 Atlantic White-sided Dolphin (Lagenorhynchus acutus)

The Atlantic white-sided dolphin is robust and attains a body length of approximately 2.8 m (Jefferson et al. 2008). It is more colorful than most dolphins and is characterized by a bright white patch on the side that extends from below the dorsal fin toward the tail flukes as a yellowish blaze above a thin dark stripe (Cipriano 2018). Atlantic white-sided dolphins feed mostly on small schooling fishes (e.g., herring, mackerel, hake, sand lance) and squid, and are often observed feeding in mixed-species groups with baleen whales and other dolphin species (Jefferson et al. 2008; Cipriano 2018). Behaviorally, this species is highly social, but not as demonstrative as some other common dolphins. Off New England, typical group size is around 40 individuals, but can range from a few to ~500 animals (Cipriano 2018).

Like most dolphin species, Atlantic white-sided dolphins produce clicks, buzzes, calls, and whistles. Their clicks are broadband sounds ranging from 30 to 40 kHz that can contain frequencies over 100 kHz and are often produced during foraging and for orientation within the water column. Buzzes and calls are not as well studied, and they may be used for socialization as well as foraging. Whistles are primarily for social communication and group cohesion and are characterized by a down sweep followed by an upsweep with an approximate starting frequency of 20 kHz and ending frequency of 17 kHz (Hamran 2014). No hearing sensitivity data are currently available for this species (Southall et al. 2019).

4.2.3.1 Distribution

Atlantic white-sided dolphins are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence; they are rarely seen off the coast of Nova Scotia (Kenney and Vigness-Raposa 2010). The species occurs year-round between central West Greenland to North Carolina primarily in continental shelf waters to the 100-m (328-ft) depth contour (NMFS 2024a). There are seasonal shifts in the distribution of the Atlantic white-sided dolphins off the northeastern US coast, with low abundance in winter between Georges Basin and Jeffrey’s Ledge and very high abundance in the Gulf of Maine during spring. During summer, Atlantic white-sided dolphins are most abundant between Cape Cod and the lower Bay of Fundy. During fall, the distribution of the species is similar to that in summer, with less overall abundance (DoN 2005).

Kraus et al. (2016) suggest that Atlantic white-sided dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for Atlantic white-sided dolphins could not be calculated because this species was only observed on eight occasions throughout the duration of the study (October 2011 through June 2015). No Atlantic white-sided dolphins were observed during winter, and this species was only sighted twice in the fall and three times in the spring and summer. It is possible that the NLPSC survey may have underestimated the abundance of Atlantic white-sided dolphins because this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species.

During continued aerial surveys in the MA and RI/MA WEA study area, between October 2018 and August 2019, Atlantic white-sided dolphins were only observed during the months of April through July, and only on the western side of the survey area (O'Brien et al. 2020). Between March and October 2020, there was only a single sighting of this species (15 individuals) in the MA and RI/MA WEAs, which occurred in summer (O'Brien et al. 2021). During the September 2020 through October 2021 study period, there was one sighting of nine individuals (O'Brien et al. 2022) and during the February–August 2022 surveys (O'Brien et al. 2023), there was one sighting of ten Atlantic white-sided dolphins.

Atlantic white-sided dolphins were observed 4 times (37 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Atlantic white-sided dolphins were observed only in the summer during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest Atlantic white-sided dolphins are most abundant in the area during the spring, and present in lower, but similar, numbers during the other three seasons (Palka et al. 2021).

4.2.3.2 Abundance

The best abundance estimate currently available for the Western North Atlantic stock is 93,233 individuals based on surveys conducted between Labrador and central Virginia (NMFS 2024a). A trend analysis is not currently available for this stock due to insufficient data (NMFS 2024a).

4.2.3.3 Status

Atlantic white-sided dolphins are not listed under the ESA or considered a strategic stock under the MMPA (NMFS 2024a). The PBR for this stock is 544 and the annual rate of human-caused mortality and serious injury from 2017 to 2021 was estimated to be 28.2 (NMFS 2024a). This estimate is based on observed fishery interactions, but Atlantic white-sided dolphins are also threatened by contaminants in their habitat, climate-related shifts in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.2.4 Common Bottlenose Dolphin (Tursiops truncatus)

Common bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 2–4 m in length (NMFS 2023g). The snout is stocky and set off from the head by a crease. They are typically light to dark gray in color with a white underside (Jefferson et al. 1993). Bottlenose dolphins are considered generalist feeders and consume a wide variety of organisms, including fish, squid, and shrimp and other crustaceans (Jefferson et al. 2008).

Whistles produced by bottlenose dolphins can vary over geographic regions, and newborns are thought to develop "signature whistles" within the first few months of their lives that are used for intraspecific communication. Whistles generally range in frequency from 300 Hz to 39 kHz with SLs between 114 and 163 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Bottlenose dolphins also make burst-pulse sounds and echolocation clicks, which can range from a few kHz to over 150 kHz. As these sounds are used for locating and capturing prey, they are directional calls; the recorded frequency and sound level can vary depending on whether the sound was received head-on or at an angle relative to the vocalizing dolphin. SLs for burst-pulses and clicks range between 193 and 228 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). There are sufficient available data for bottlenose dolphin hearing sensitivity using both behavioral and auditory evoked potential (AEP) methods as well as anatomical modeling studies, which show hearing for the species is most sensitive between approximately 400 Hz and 169 kHz (Southall et al. 2019).

4.2.4.1 Distribution

In the western North Atlantic, there are two morphologically and genetically distinct bottlenose dolphin morphotypes – offshore and coastal (Hoelzel et al. 1998; Rosel et al. 2009). The stock occurring near the Offshore Development Area is the Western North Atlantic Offshore stock (NMFS 2024a). The coastal morphotype was recently described as a separate species, *Tursiops erebennus* (Costa et al. 2022). The offshore stock is primarily distributed along the outer shelf and slope from Georges Bank to Florida during spring and summer and has been observed in the Gulf of Maine during late summer and fall (NMFS 2024a), whereas the coastal morphotype is distributed along the coast between southern Long Island, New York, and Florida (Hayes et al. 2021). Because the northern limit of the coastal stock is approximately Sandy Hook, NJ (Hayes et al. 2021), only the offshore stock is likely to occur in the Offshore Development Area.

Kraus et al. (2016) observed common bottlenose dolphins during all seasons within the MA and RI/MA WEAs in the 2011–2015 NLPSC aerial survey. This was the second most commonly observed small cetacean species and exhibited little seasonal variability in abundance. One sighting of common bottlenose dolphins in the Kraus et al. (2016) study included calves, and one sighting involved mating behavior. It is possible that the NLPSC survey may have underestimated the abundance of common bottlenose dolphins because this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species (Kraus et al. 2016).

During continued aerial surveys in the MA and RI/MA WEA study area, between October 2018 and August 2019, common bottlenose dolphins were the second most abundant small cetacean, accounting for 15% of sightings (O'Brien et al. 2020). They were seen throughout the study area, but only during April through July. During the March–October 2020 surveys, common bottlenose dolphins accounted for 22% of small cetacean sightings. They were seen only in the summer and only in the southern portion of the study area (O'Brien et al. 2021). During the September 2020–October 2021 study period, they accounted for 10% of cetacean sightings, and similar to the previous study they were only seen in the southern part of the study area (O'Brien et al. 2022). They were seen in every season except fall. During the February–August 2022 surveys, they accounted for 18% of small cetacean sightings and were seen in all seasons surveyed. They were seen primarily in the center of the WEAs and less commonly over the Nantucket Shoals (O'Brien et al. 2023).

Common bottlenose dolphins were observed 149 times (1944 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Common bottlenose dolphins were observed in both seasons of the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest common bottlenose dolphins are most abundant in the area during the summer followed by the spring, and present in lower, but similar, numbers during fall and winter (Palka et al. 2021).

4.2.4.2 Abundance

The best abundance estimate for the Western North Atlantic offshore stock is 64,587 individuals based on surveys conducted in the summer of 2021 in waters from the lower Bay of Fundy to central Florida (NMFS 2024a). A population trend analysis for this stock was conducted using abundance estimates from 2004, 2011, 2016, and 2021, which show no statistically significant trend (NMFS 2024a).

4.2.4.3 Status

Common bottlenose dolphins are not listed under the ESA and the stock of bottlenose dolphins that occurs in the Offshore Development Area is not considered strategic under the MMPA (NMFS 2024a). The PBR for this stock is 507, and the average annual human-cause mortality and serious injury attributed to fishery interactions from 2017 to 2021 was estimated to be 28 (NMFS 2024a). In addition to fisheries, threats to common bottlenose dolphins include non-fishery related human interaction, anthropogenic noise, offshore development, contaminants in their habitat, climate-related changes in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.2.5 Common Dolphin (Delphinus delphis)

Two common dolphin species were previously recognized: the long-beaked common dolphin (*D. capensis*) and short-beaked common dolphin (*D. delphis*); however, Cunha et al. (2015) summarized the relevant data and analyses along with additional molecular data and analysis and recommended that the long-beaked common dolphin not be further recognized in the Atlantic Ocean. Thus, only a single species of common dolphin exists in the North Atlantic Ocean. Adult common dolphins are 1.5–2.3 m in length with a tall dorsal fin and long beak. They have a distinct crisscross coloration with a four-part pattern of a dark gray to black cap, buff to pale yellow anterior portion, light-to-medium gray flank patch, and white abdomen (Perrin 2018). This species feeds on schooling fish and squid found near the surface at night (NMFS 2023f). Common dolphins are a highly social and energetic species that usually travels in large pods consisting of 50 to >1,000 individuals (Cañadas and Hammond 2008). The common dolphin can frequently be seen performing acrobatics and interacting with large vessels and other marine mammals.

Common dolphin clicks are broadband sounds between 17 and 45 kHz with peak energy between 23 and 67 kHz. Burst-pulse sounds are typically between 2 and 14 kHz while the key frequencies of common dolphin whistles are between 3 and 24 kHz (Erbe et al. 2017). No hearing sensitivity data are available for this species (Southall et al. 2019).

4.2.5.1 Distribution

The common dolphin is the most abundant dolphin in warm-temperate waters of the Atlantic and Pacific oceans (Perrin 2018). Common dolphins in the US Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras, North Carolina to the Scotian Shelf (NMFS 2024a). Common dolphins are a highly seasonal, migratory species. In the US Atlantic EEZ this species is distributed along the continental shelf between the 200 and 2,000 m isobaths and is associated with Gulf Stream features (CeTAP 1982; Hamazaki 2002; NMFS 2024a). Common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to fall (NMFS 2024a). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 11°C (Sergeant et al. 1970; Gowans and Whitehead 1995).

Kraus et al. (2016) suggested that common dolphins occur year-round in the MA and RI/MA WEAs and surrounding areas based on data from the 2011–2015 NLPSC aerial survey. They were the most frequently observed small cetacean species within the Kraus et al. (2016) study area. Common dolphins were observed in the MA and RI/MA WEAs in all seasons but were most frequently observed during the summer months; observations of this species peaked between June and August. Two sightings of common dolphins in the Kraus et al. (2016) study included calves, two sightings involved feeding behavior, and three sightings involved mating behavior. Sighting data indicate that common dolphin distribution tended to be farther offshore during the winter months than during spring, summer, and fall. It is possible that the NLPSC survey may have underestimated the abundance of common dolphins, because this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species (Kraus et al. 2016).

During continued aerial surveys in the MA and RI/MA WEA study area, between October 2018 and August 2019, common dolphins were the most commonly sighted small cetacean, observed in all seasons and throughout the study area (O'Brien et al. 2020). They were most abundant during summer, followed by fall, winter, and then spring. During the March–October 2020 surveys, common dolphins accounted for 41% of small cetacean sightings and again were seen in all seasons and throughout the study area (O'Brien et al. 2021). During the September 2020–October 2021 study period, they accounted for 39% of small cetacean sightings, and similar to the previous studies they were seen in all seasons and throughout the study area (O'Brien et al. 2022). During the February–August 2022 surveys, they accounted for 50% of small cetacean sightings and were seen in all seasons surveyed. They were seen primarily in the center of the WEAs and less commonly over the Nantucket Shoals (O'Brien et al. 2023).

Common dolphins were observed 914 times (16,300 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Common dolphins were observed in both seasons of the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest common dolphins are most abundant in the area during the summer followed by the fall, spring, and then winter (Palka et al. 2021).

4.2.5.2 Abundance

The best available abundance estimate for the Western North Atlantic stock of common dolphins is 93,100 individuals based on NEFSC and SEFSC surveys conducted in 2021 between the lower Bay of Fundy and central Florida (NMFS 2024a). A trend analysis has not been conducted for this stock because of insufficient data (NMFS 2024a).

4.2.5.3 Status

The common dolphin is not listed under the ESA and the western North Atlantic stock is not considered strategic under the MMPA (NMFS 2024a). Historically, this species was hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from commercial fisheries (NMFS 2024a). The common dolphin faces anthropogenic threats because of its utilization of nearshore habitat and highly social nature, but it is not considered a strategic stock under the MMPA because the average annual human-caused mortality and serious injury does not exceed the calculated PBR of 599 for this stock (NMFS 2024a). The annual estimated human-caused mortality and serious injury for 2017 to 2021 was 413.8, which includes fishery-interactions and research mortality (NMFS 2024a). Other threats to this species include contaminants in their habitat, climate-related changes in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a). There is no designated critical habitat for this stock in the Offshore Development Area.

4.2.6 False Killer Whale (Feresa attenuata)

False killer whales have a rounded head, relatively small dorsal fin and are dark gray in color, often appearing black, with a maximum length of approximately 6 m (~20 ft) (Baird 2018). This species is gregarious and individuals form strong social bonds (Baird 2018). They are typically found in groups of 5–25 individuals (Baird 2018), although groups of several hundred are sometimes observed (Odell and McClune 1999).

4.2.6.1 Distribution

The false killer whale is found worldwide in tropical and temperate waters generally between 50ºN and 50ºS (Odell and McClune 1999). They occur primarily in open ocean but occasionally can be found on the continental shelf and in nearshore areas around tropical oceanic islands (Baird 2018). In the western Atlantic, they are found from Maryland to Argentina (Rice 1998). Sightings of this species in the U.S. western North Atlantic are uncommon but the few sightings along with stranding and bycatch records suggest they occur routinely in the U.S. Atlantic, with sightings from Florida to Maine (Hayes et al. 2020). A group of five false killer whales was observed in 2019 and a single false killer whale was observed in 2021 during site characterization surveys of a nearby lease area (Vineyard Wind 2019, 2021).

4.2.6.2 Abundance

The best available abundance estimate for the western North Atlantic stock of this species is 1,791 individuals based on 2016 surveys from the lower Bay of Fundy to central Florida (Hayes et al. 2020).

4.2.6.3 Status

False killer whales are not listed as threatened or endangered under the ESA and the species is not considered a strategic stock under the MMPA (Hayes et al. 2020).

4.2.7 Killer Whale (Orcinus orca)

Killer whales have a very distinctive appearance, mostly black on top and white underneath and with a distinctive white eye patch (NMFS 2024d). Killer whales are the largest members of the delphinid family that includes dolphins and other large species such as pilot whales, with maximum lengths up to 9.7 m (32 ft) (NMFS 2024d). Killer whales are considered a top predator, eating at the top of the food web, with diets consisting of fish, squid, and other marine mammals (NMFS 2024d). This species is very social and lives in pods of maternally related individuals, generally staying with the pod they were born into their whole lives (NMFS 2024d).

4.2.7.1 Distribution

The killer whale is cosmopolitan and globally fairly abundant; it has been observed in all oceans of the world (Ford 2018). It is very common in temperate waters and also frequents tropical waters, at least seasonally (Heyning and Dahlheim 1988). Killer whales tend to be more common in nearshore areas and at higher latitudes (Jefferson et al. 2015). The greatest abundance is thought to occur within 800 km of major continents (Mitchell 1975). In the Northwest Atlantic, killer whales occur from the polar pack ice to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the Northwest Atlantic (Katona et al. 1988). They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). A group of two killer whales was observed during a UXO survey along the export cable corridor north of the Vineyard Wind 1 Lease Area in March 2022. In June 2023, a pod of four killer whales was seen approximately 64 km (40 mi.) south of Nantucket by NEAq observers during an aerial survey (NEAq 2023).

4.2.7.2 Abundance

The total number of killer whales in the western North Atlantic stock is unknown (Waring et al. 2014).

4.2.7.3 Status

Killer whales of the U.S. Atlantic are not listed as threatened or endangered under the ESA and the species in this region is not considered a strategic stock under the MMPA (Waring et al. 2014).

4.2.8 Pilot Whale (Globicephalus melas and G. macrorhynchus)

Two species of pilot whale occur within the western North Atlantic: the long-finned pilot whale and the short-finned pilot whale. The two species are difficult to differentiate at sea and cannot be reliably distinguished during most surveys (Rone and Pace 2012; NMFS 2024a). Both short-finned and long-finned pilot whales are similar in coloration and body shape. Pilot whales have bulbous heads, are dark black in color, and can reach approximately 7.3 m in length (NMFS 2023d). However, long-finned pilot whales can be distinguished by their long flippers, which are 18 to 27% of the body length with a pointed tip and angled leading edge (Jefferson et al. 1993). These whales form large, relatively stable aggregations that appear to be maternally determined (ACS 2018). Long-finned pilot whales can dive up to 600 m where they feed primarily on fish, cephalopods (squid and octopus), and crustaceans (NMFS 2023d).

Like dolphin species, pilot whales can produce whistles and burst-pulses used for foraging and communication. Whistles typically range in frequency from one to 11 kHz while burst-pulses cover a broader frequency range from 100 Hz to 22 kHz (Erbe et al. 2017). AEP measurements conducted by Pacini et al. (2010) on a long-finned pilot whale indicate that the hearing sensitivity for this species ranges from <4 kHz to 89 kHz.

4.2.8.1 Distribution

Because it is difficult to differentiate between the two pilot whale species in the field, sightings are usually reported to genus level only (CeTAP 1982; NMFS 2024a). However, short-finned pilot whales are a southern or tropical species and pilot whale sightings above approximately 42° North (N) are most likely long-finned pilot whales. Short-finned pilot whale occurrence in the Offshore Development Area is considered uncommon (CeTAP 1982; NMFS 2024a). Long-finned pilot whales are distributed along the continental shelf waters off the northeastern US in the winter and early spring. By late spring, pilot whales migrate into more northern waters including Georges Bank and the Gulf of Maine and will remain there until fall (CeTAP 1982; NMFS 2024a). The two species' ranges overlap spatially along the shelf break between the southern flank of Georges Bank and New Jersey (Rone and Pace 2012; NMFS 2024a).

Kraus et al. (2016) observed pilot whales infrequently in the MA and RI/MA WEAs and surrounding areas during the 2011–2015 NLPSC aerial survey. Effort-weighted average sighting rates for pilot whales could not be calculated. No pilot whales were observed during the fall or winter, and these species were only observed 11 times in the spring and three times in the summer. Two of these sightings included calves. It is possible that the NLPSC survey may have underestimated the abundance of pilot whales, as this survey was designed to target large cetaceans and most small cetaceans were not identified to species (Kraus et al. 2016).

During continued aerial surveys in the MA and RI/MA WEA study area between October 2018 and August 2019, pilot whales were observed only between April and July and only on the eastern side of the study area south of Nantucket Shoals (O'Brien et al. 2020). Between March and October 2020 (O'Brien et al. 2021) and during the September 2020 through October 2021 study period, no pilot whales were seen (O'Brien et al. 2022). During the February–August 2022 surveys, there were 4 sightings of 72 pilot whales (O'Brien et al. 2023). This species was only seen during the spring.

Long-finned pilot whales were observed once (3 individuals) and unidentified pilot whales were observed 9 times (234 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Long-finned pilot whales were observed only in the summer during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest pilot whales are most abundant in the area during the summer, followed by fall and then spring, and least abundant, though still present, during winter (Palka et al. 2021). Those abundance estimates suggest that approximately 80% of the pilot whales seen in the RI/MA WEA year-round are long-finned and approximately 20% are short-finned pilot whales

(Palka et al. 2021). Those proportions were used through this request to scale Roberts et al. (2016; 2023; 2024) pilot whale guild densities.

4.2.8.2 Abundance

The best available estimate of long-finned pilot whales in the western North Atlantic is 39,215 individuals based on recent surveys covering waters between Labrador and central Virginia (NMFS 2024a). A trend analysis has not been conducted for this stock due to the relatively imprecise abundance estimates (NMFS 2024a). The best available estimate of short-finned pilot whales in the western North Atlantic is 18,726 individuals from summer 2021 shipboard surveys from central Florida to the lower Bay of Fundy (NMFS 2024a). No significant trend was found in short-finned pilot whale abundance estimates from 2004, 2011, 2016, and 2021.

4.2.8.3 Status

Long-finned pilot whales are not listed as threatened or endangered under the ESA (NMFS 2024a). Pilot whales have a propensity to mass strand, although the role of human activity in these strandings remains unknown (NMFS 2024a). The PBR for the western North Atlantic stock of long-finned pilot whales is 306, and the average annual mortality and serious injury incidental to U.S. fisheries was estimated to be 5.7 between 2017 and 2021 (NMFS 2024a). Sixty-eight long-finned pilot whales were reported stranded during that time with 5 of those in Massachusetts (NMFS 2024a) Short-finned pilot whales are not listed as threatened or endangered under the ESA, but the western North Atlantic stock is considered strategic because the mean annual human-caused mortality and serious injury exceeds the PBR of 143. The mean annual mortality incidental to the U.S. commercial large pelagics longline fishery for 2017–2021 was 218 short-finned pilot whales. During 2017–2021, 65 short-finned pilot whales were reported stranded along the US east coast between Massachusetts and Florida. Threats to both pilot whale species include entanglement in fishing gear, contaminants, anthropogenic noise, climate-related shifts in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.2.9 Risso's Dolphin (Grampus griseus)

The Risso's dolphin attains a body length of approximately 2.6–4 m (NMFS 2023i). Unlike most other dolphins, Risso's dolphins have blunt heads without distinct beaks. Coloration for this species ranges from dark to light gray. Adult Risso's dolphins are typically covered in white scratches and spots that can be used to identify the species in field surveys (Jefferson et al. 1993). The Risso's dolphin forms groups ranging from 10 to 30 individuals and primarily feed on squid, but also fish such as anchovies (*Engraulidae*), krill, and other cephalopods (NMFS 2023i).

Whistles for this species have frequencies ranging from around 4 kHz to over 22 kHz with estimated SLs between 163 and 210 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Studies using both behavioral and AEP methods have been conducted for this species, which show greatest auditory sensitivity between <4 kHz to >100 kHz (Nachtigall et al. 1995; Nachtigall et al. 2005).

4.2.9.1 Distribution

Risso's dolphins in the US Atlantic EEZ are part of the Western North Atlantic Stock. This stock inhabits waters from Florida to eastern Newfoundland (Leatherwood et al. 1976; Baird and Stacey 1991).

Off the northeastern US Coast, Risso's dolphins are primarily concentrated along the continental shelf edge, but they can also be found swimming in shallower waters to the mid-shelf (Hayes et al. 2022). During spring, summer, and fall, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank (CeTAP 1982; Payne et al. 1984). During the winter, the distribution extends outward into oceanic waters (Payne et al. 1984). The stock may contain multiple demographically independent populations that should themselves be stocks because the current stock spans multiple eco-regions (Ljungblad et al. 1988; Spalding et al. 2007).

Kraus et al. (2016) results from the 2011–2015 NLPSC aerial survey suggest that Risso's dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for Risso's dolphins could not be calculated. No Risso's dolphins were observed during summer, fall, or winter, and this species was only observed twice in the spring. It is possible that the NLPSC survey may have underestimated the abundance of Risso's dolphins, as this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species.

Risso's dolphins were not observed during continued aerial surveys in the Kraus et al. (2016) MA and RI/MA WEA study area between 2018 and 2022 (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023).

Risso's dolphins were observed once (12 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Risso's dolphins were observed in both seasons of the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest Risso's dolphins are most abundant in the area during the summer followed by the fall, and less abundant during spring and winter (Palka et al. 2021).

4.2.9.2 Abundance

The best abundance estimate for the Western North Atlantic stock of Risso's dolphins is 44,067 individuals based on NEFSC and SEFSC surveys conducted in 2021 between the lower Bay of Fundy and central Florida (NMFS 2024a). A trend analysis was not conducted on this species, because there are insufficient data to generate this information (NMFS 2024a).

4.2.9.3 Status

Risso's dolphins are not listed as threatened or endangered under the ESA (NMFS 2024a). The PBR for this stock is 307, and the annual average human-caused mortality and injury for 2017 to 2021 was estimated to be 18 (NMFS 2024a). This stock is not classified as strategic under the MMPA because mortality does not exceed the calculated PBR. Threats to this stock include fishery interactions, non-fishery related human interaction, contaminants in their habitat, climate-related shifts in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.2.10 White-beaked Dolphin (Lagenorhynchus albirostris)

White-beaked dolphins are typically black on the back with a white saddle behind the dorsal fin and whitish bands on the flank. Their beaks are short, only 5-8 cm (2-3 inches) long, and their maximum size is 3.1 m (Kinze 2018). White-beaked dolphins readily approach vessels and frequently jump out of the water. This species is often seen in mixed groups with common dolphins, common bottlenose dolphins, Risso's dolphins, and even sei and humpback whales (Kinze 2018).

4.2.10.1 Distribution

The white-beaked dolphin occurs in cold temperate and subpolar regions of the North Atlantic; its range extends from Cape Cod to southern Greenland in the western North Atlantic and Portugal to Svalbard in the eastern North Atlantic (Jefferson et al. 2015; Kinze 2018). It appears to prefer deep waters along the outer shelf and slope but can also occur in shallow areas and far offshore (Jefferson et al. 2015). There are four main high-density centers in the North Atlantic: (1) the Labrador Shelf, (2) Icelandic waters, (3) waters around Scotland, and (4) the shelf along the coast of Norway (Kinze 2018). White-beaked dolphins were observed in the past in shallow, coastal waters near Cape Cod during the Cetacean & Turtle Assessment Program (CETAP) surveys (CeTAP 1982). They have occasionally been observed during AMAPPS surveys, but all of those sightings were far offshore, in the Gulf of Maine, or off Nova Scotia, Canada (NEFSC and SEFSC Palka et al. 2017; 2020). They were not observed during other aerial surveys in the RI/MA WEA (Kraus et al. 2016; O'Brien et al. 2020; 2021, 2022; 2023), although those surveys were focused on large whales. A group of 30 white-beaked dolphins was observed during 2019 site characterization surveys of a nearby lease area (Vineyard Wind 2019).

4.2.10.2 Abundance

The best available abundance estimate for the western North Atlantic stock of white-beaked dolphins is 536,016 individuals based on surveys in Canadian Atlantic waters in 2016 (Hayes et al. 2020).

4.2.10.3 Status

White-beaked dolphins are not listed as endangered under the ESA and they are not considered strategic under the MMPA because the estimated average annual human-related mortality does not exceed the PBR of 4,153 (Hayes et al. 2020).

4.2.11 Harbor Porpoise (Phocoena phocoena)

This species is among the smallest of the toothed whales and is the only porpoise species found in northeastern US waters. A distinguishing physical characteristic is the dark stripe that extends from the flipper to the eye. The rest of its body has common porpoise features; a dark gray back, light gray sides, and small, rounded flippers (Jefferson et al. 1993). It reaches a maximum length of 1.8 m and feeds on a wide variety of small fish and cephalopods (Reeves and Read 2003; Kenney and Vigness-Raposa 2010). Most harbor porpoise are observed in small groups, usually between five and six individuals, although they aggregate into larger groups for feeding or migration (Jefferson et al. 2008).

Harbor porpoises produce high frequency clicks with a peak frequency between 129 and 145 kHz and an estimated SLs that ranges from 166 to 194 dB re 1 µPa @ 1 m SPL_{rms} (Villadsgaard et al. 2007). Available data estimating auditory sensitivity for this species suggest that they are most receptive to noise between 300 Hz and 160 kHz (Southall et al. 2019).

4.2.11.1 Distribution

The harbor porpoise is mainly a temperate, inshore species that prefers to inhabit shallow, coastal waters of the North Atlantic, North Pacific, and Black Sea. Harbor porpoises mostly occur in shallow shelf and coastal waters. In the summer, they tend to congregate in the northern Gulf of Maine, southern Bay of Fundy, and around the southern tip of Nova Scotia (NMFS 2024a). In the fall and spring, harbor porpoises are widely distributed from New Jersey to Maine (NMFS 2024a). In the winter, intermediate densities can be found from New Jersey to North Carolina, with lower densities from New York to New Brunswick, Canada (Kenney and Vigness-Raposa 2010). In cooler months, harbor porpoises have been observed from the coastline to deeper waters (>1,800 m), although the majority of sightings are over the continental shelf (NMFS 2024a).

Kraus et al. (2016) indicate that harbor porpoises occur within the MA and RI/MA WEAs in fall, winter, and spring. Harbor porpoises were observed in groups ranging in size from three to 15 individuals and were primarily observed in the Kraus et al. (2016) study area from November through May, with very few sightings during June through September. It is possible that the NLPSC survey may have underestimated the abundance of harbor porpoise because this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species (Kraus et al. 2016).

During continued aerial surveys in the MA and RI/MA WEA study area, between October 2018 and August 2019, harbor porpoises accounted for 15% of small cetacean sightings, and were seen in all seasons except fall (O'Brien et al. 2020). They were distributed farther north in the MA and RI/MA WEAs than the other small cetacean species. During the March–October 2020 surveys, there were only two sightings of single harbor porpoises and these occurred during the summer months (O'Brien et al. 2021). During the September 2020–October 2021 study period, similar to the 2018–2019 study, harbor porpoise were seen in every season except fall (O'Brien et al. 2022). During the February–August 2022 surveys, this species accounted for <1% of small cetacean sightings and they were only seen during the spring (O'Brien et al. 2023).

Harbor porpoise were not observed during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Harbor porpoises were observed only in summer during the 2010–2017 AMAPPS Northeast shipboard surveys conducted during summer and fall and were observed in all four seasons during the 2010–2017 AMAPPS Northeast aerial surveys (Palka et al. 2021). Those surveys were used to calculate seasonal abundance estimates for the RI/MA WEA study area (which includes a 10-km buffer around the WEA) that suggest harbor porpoises are most abundant in the area during the winter and spring, and less abundant though still quite common during the summer and fall (Palka et al. 2021).

4.2.11.2 Abundance

The best available abundance estimate for the Gulf of Maine/Bay of Fundy stock occurring in the Offshore Development Area is 85,765 individuals based on NEFSC and SEFSC surveys conducted in 2021 between the lower Bay of Fundy and central Florida (NMFS 2024a). A population trend analysis is not available because data are insufficient for this species (NMFS 2024a).

4.2.11.3 Status

This species is not listed under the ESA and is considered non-strategic under the MMPA (NMFS 2024a). The PBR for this stock is 649, and the estimated annual average human-caused mortality and serious injury from 2017 to 2021 was 145.4 (NMFS 2024a). This species faces major anthropogenic impacts because of its nearshore habitat. Historically, Greenland populations were hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from western North Atlantic fishing activities such as gillnets and bottom trawls (NMFS 2024a). There were 305 strandings of this species along the U.S. Atlantic coast during 2017–2021, with 137 of those in Massachusetts. Harbor porpoises also face threats from contaminants in their habitat, vessel traffic, habitat alteration due to offshore development, climate-related shifts in prey distribution, and climate-related spatial distribution shifts in their seasonal core habitat (Chavez-Rosales et al. 2022; NMFS 2024a).

4.3 Pinnipeds

4.3.1 Gray Seal (Halichoerus grypus)

Gray seals are the second most common pinniped in the US Atlantic EEZ (Jefferson et al. 2008). This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). Gray seals are large, reaching 2–3 m in length, and have a silver-gray coat with scattered dark spots (NMFS 2023k). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, gray seals can dive to depths of 300 m, and frequently forage on the outer shelf (Hammill et al. 2001; Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (NMFS 2023k). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NMFS 2023k).

Two types of underwater vocalizations have been recorded for male and female gray seals; clicks and hums. Clicks are produced in a rapid series resulting in a buzzing noise with a frequency range between 500 Hz and 12 kHz. Hums, which is described as being similar to that of a dog crying in its sleep, are lower frequency calls, with most of the energy <1 kHz (Schusterman et al. 1970). AEP studies indicate that hearing sensitivity for this species is greatest between 140 Hz and 100 kHz (Southall et al. 2019).

4.3.1.1 Distribution

Gray seals are found on both sides of the North Atlantic and these populations are genetically distinct (NMFS 2024a). The Northwest Atlantic population is equivalent to the Western North Atlantic Stock that occurs in US waters. This stock ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957; Mansfield 1966; Katona et al. 1993; Hammill et al. 2001). There are three breeding concentrations in eastern Canada: Sable Island, the Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). These are divided into two management areas – Scotian Shelf (Sable Island and coastal Nova Scotia) and the Gulf (DFO 2022). In US waters, gray seals breed on several isolated islands along the Maine coast and in Nantucket Sound, Massachusetts (NMFS 2024a). Following the breeding season, gray seals may spend several weeks ashore in the late spring and early summer while undergoing a yearly molt. Outside the breeding season, the U.S. and Canadian breeding aggregations mix (NMFS 2024a).

Kraus et al. (2016) observed gray seals in the MA and RI/MA WEAs and surrounding areas during the 2011–2015 NLPSC aerial survey, but this survey was designed to target large cetaceans so locations and numbers of seal observations were not included in the study report. During continued aerial surveys in the Kraus et al. (2016) study area, gray seals were seen during the October 2018–August 2019 study period (O'Brien et al. 2020), September 2020–October 2021 study period (O'Brien et al. 2022), and during the February–August 2022 surveys (O'Brien et al. 2023). All seals observed during the March–October 2020 surveys were unidentified to species (O'Brien et al. 2021).

Gray seals were observed 123 times (129 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024). Gray seals were regularly observed in the MA WEA and nearby waters during all seasons of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). Gray seals tagged near Cape Cod during Phase I of AMAPPS showed strong site fidelity to Cape Cod throughout the summer and fall then movement south and east toward Nantucket beginning in mid-December (Palka et al. 2017). One pup tagged in January spent most of the month that the tag was active in the MA WEA.

4.3.1.2 Abundance

The best available abundance estimate for the Western North Atlantic stock of gray seals in US waters is 27,911 individuals, based on the ratio of total population size to number of pups in Canadian waters (NMFS 2024a). The total gray seal population in Canada is estimated at 424,300 individuals (NMFS 2024a). The stock size of gray seals is likely increasing in the US Atlantic EEZ as the number of pups born at most US breeding colonies is increasing and as Canadian seals migrate to the region (NMFS 2024a).

4.3.1.3 Status

The Western North Atlantic stock of gray seals is not listed under the ESA and is not considered strategic under the MMPA because anthropogenic mortality does not exceed PBR (NMFS 2024a). The PBR for this stock is 24,104, and the annual human-caused mortality and serious injury between 2017 and 2021 was estimated to be 4,570 in both the US and Canada (NMFS 2024a). Like harbor seals, the gray seal was hunted in New England waters until the late 1960s and this may have depleted this stock, which has since been recolonized from Canadian gray seals (NMFS 2024a). Mortality is currently attributed to fishery interactions, non-fishery related human interactions, and research activities, as well as the Canadian commercial harvest, DFO Canada scientific collection, and removal of nuisance animals in Canada (NMFS 2024a).

4.3.2 Harbor Seal (Phoca vitulina)

The harbor seal is one of the smaller pinnipeds, and adults are often light to dark gray or brown with a paler belly and dark spots covering the head and body (Jefferson et al. 1993; Kenney and Vigness-Raposa 2010). This species is approximately 2 m in length (NMFS 2023a). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Harbor seals consume a variety of prey, including fish, shellfish, and crustaceans (Bigg 1981; Reeves et al. 1992; Burns 2002; Jefferson et al. 2008). They commonly occur in coastal waters and on coastal islands, ledges, and sandbars (Jefferson et al. 2008).

Male harbor seals have been documented producing an underwater roar call which is used for competition with other males and attracting mates. These are relatively short calls with a duration of about two seconds and a peak frequency between one and two kHz (Van Parijs et al. 2003). Behavioral audiometric studies for this species estimate peak hearing sensitivity between 100 Hz and 79 kHz (Southall et al. 2019).

4.3.2.1 Distribution

The harbor seal is found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30°N and is the most abundant pinniped in the US Atlantic EEZ (Hayes et al. 2022). Harbor seals, also known as common seals, are one of the most widely distributed seal species in the Northern Hemisphere. They can be found inhabiting coastal and inshore waters from temperate to polar latitudes. Harbor seals occur seasonally along the coast during winter months from southern New England to New Jersey, typically from September through late May (Kenney and Vigness-Raposa 2010; Hayes et al. 2022). In recent years, this species has been seen regularly as far south as North Carolina, and regular seasonal haul-out sites of up to 40-60 animals have been documented on the eastern shore of Virginia and the Chesapeake Bay (Jones and Rees 2020). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005; Hayes et al. 2022). Genetic variability from different geographic populations has led to five subspecies being recognized. Peak breeding and pupping times range from February to early September, and breeding occurs in open water (Temte 1994).

Kraus et al. (2016) observed harbor seals in the MA and RI/MA WEAs and surrounding areas during the 2011–2015 NLPSC aerial survey, but this survey was designed to target large cetaceans so locations and numbers of seal observations were not included in the study report. Harbor seals have five major haul-out sites in and near the MA and RI/MA WEAs: Monomoy Island, the northwestern side of Nantucket Island, Nomans Land, the north side of Gosnold Island, and the southeastern side of Naushon Island (Payne and Selzer 1989). Payne and Selzer (1989) conducted aerial surveys and found that for haul-out sites in Massachusetts and New Hampshire, Monomoy Island had approximately twice as many seals as any of the 13 other sites in the study (maximum count of 1,672 in March of 1986). During continued aerial surveys in the Kraus et al. (2016) study area, unidentified seals were sighted in all study years but there were no seal sightings positively identified as harbor seals (O'Brien et al. 2020; O'Brien et al. 2021, 2022; O'Brien et al. 2023). However, it is likely that at least some of the sightings in the MA WEA were of harbor seals. Harbor seals were observed in the MA WEA and nearby waters during spring, summer, and fall of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). Harbor seals were observed 24 times (26 individuals) during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024).

4.3.2.2 Abundance

The best available abundance estimate for harbor seals in the Western North Atlantic is 61,336 individuals (Hayes et al. 2022). Estimates of abundance are based on surveys conducted during the pupping season, when most of the population is assumed to be congregated along the Maine coast. Abundance estimates do not reflect the portion of the stock that might pup in Canadian waters (Hayes et al. 2022). There is no clear trend in the current abundance estimates. Trends were estimated for 1993 to 2018 using a Bayesian hierarchical model to account for missing data both within and between survey years. The estimated mean change in non-pup harbor seal abundance per year was positive from 2001 to 2004, but close to zero or negative between 2005 and 2018 (Hayes et al. 2022). After 2005, mean change in pup abundance was steady or declining until 2018 but these changes were not significant (Hayes et al. 2022).

4.3.2.3 Status

Harbor seals are not listed under the ESA and are not considered strategic because anthropogenic mortality does not exceed PBR (Hayes et al. 2022). The PBR for this population is 1,729 and the annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 399 seals per year (Hayes et al. 2022). This mortality and serious injury was attributed to fishery interactions, non-fishery related human interactions, and research activities (Hayes et al. 2022). Like the gray seal, harbor seals were hunted in New England waters until the late 1960s and this may have depleted this stock. Other threats to harbor seals include disease and predation (Hayes et al. 2022).

5 Type of Incidental Take Authorization Requested

Vineyard Northeast is requesting the promulgation of incidental take regulations and issuance of Letter(s) of Authorization (LOA[s]) pursuant to section 101(a)(5)(A) of the MMPA for incidental take by Level A and Level B harassment of small numbers of marine mammals during the construction and operations activities described in Sections 1 and 2 in and around Lease Area OCS-A 0522 and along the Massachusetts and Connecticut OECCs (Figure 1) to be effective for the five-year period from 2028–2032.

Vineyard Northeast construction activities have the potential to take marine mammals as a result of sound energy introduced into the marine environment. Sounds that may result in both Level A and Level B harassment include impulsive sounds generated by impact pile driving and explosive sounds generated by UXO detonation. Although exposure estimates predicted from modeling indicate that Level A take is possible, the mitigation and monitoring activities described in Sections 11 and 13 below are designed to minimize the likelihood that Level A take of any marine mammal species will occur. Nonetheless, Level A take is being requested for some species as a precautionary measure. Mitigation measures focused on ensuring no Level A harassment of a North Atlantic right whale will occur include restricting foundation installation and UXO detonation to the months of the year when North Atlantic right whales are unlikely to be present near the Offshore Development Area as well as significant monitoring efforts for this species (see Sections 11 and 13). Sounds generated by HRG survey equipment, vibratory hammering during cofferdam installation/removal, vibratory pile setting during foundation installation, and drilling in cases of pile refusal are only anticipated to result in potential Level B harassment. The potential effects of any take depend on the species of marine mammal, the behavior of the animal at the time the sound occurs, and the received level of the sound. Disturbance reactions are likely in the general vicinity of the sound source and could include avoidance.

6 Take Estimates for Marine Mammals

Most anticipated takes would be "takes by Level B harassment," involving temporary changes in behavior. Specifically, acoustic exposure could result in temporary displacement of marine mammals from within ensonified zones or other temporary changes in behavioral state. Of the Vineyard Northeast activities identified as having the potential to result in incidental takes by harassment (Section 1.2), only foundation installation and UXO detonation have the potential to result in Level A take. The Level A take estimates for these two activities provided below are conservative in that they assume no mitigation measures other than 10 dB of sound attenuation. Additionally, these estimates do not include any aversive behavior by the animals, although many marine mammals are known to avoid areas of loud sounds (see Section 7.1.2 for a discussion and examples). The additional mitigation measures (detailed in Section 11) when applied in practice will reduce the already very low probability of Level A take, but for certain species and activities, some potential Level A take could occur, so Level A take is requested for some species. The planned activities are not expected to "take" more than small numbers of marine mammals and will have a negligible impact on the affected species or stocks. The sections below describe the methods used to calculate potential take and present the resulting request for take authorization.

6.1 Basis for Estimating Potential "Take"

Three different methods were used to estimate "take by harassment" for the different Vineyard Northeast activities identified in Section 1.2. To estimate take incidental to impact pile driving and vibratory pile setting followed by impact pile driving during foundation installation, acoustic and animal movement modeling was conducted (Appendix A). Acoustic modeling estimates sound fields generated by various sound sources. Animal movement modeling incorporates realistic species-specific behaviors from the published literature to estimate the probability of exposure to sound above threshold levels as the simulated animals (animats) move through the predicted sound fields output from the acoustic modeling. The final output of this modeling includes estimates of the number of animats exposed to sound above Level A and Level B acoustic thresholds. Numbers of animats are then converted to numbers of real-world animals predicted to be exposed by multiplying the simulation results by estimated real-world densities from habitat-based density models (Roberts et al. 2016; 2023; 2024). Additional details of the modeling methods and resulting exposure and take estimates as well as requested take for these two activities are provided in Section 6.3.

To estimate take incidental to HRG surveys, published acoustic ranges for representative survey equipment (Crocker and Fratantonio 2016) were used to calculate areas ensonified above the Level B acoustic threshold. These areas were then multiplied by estimated real-world marine mammal densities from habitat-based density models (Roberts et al. 2016; 2023; 2024) to generate exposure estimates. Details and results from this analysis are provided in Section 6.4.

To estimate take incidental to potential drilling during foundation installation, UXO detonation, and cofferdam installation/removal at the landfall sites, acoustic modeling was conducted to predict ranges to Level A and Level B acoustic thresholds (see Appendices I, J, and K, respectively, of Appendix A). Similar to the method used to estimate HRG exposures, these ranges were then converted to ensonified areas, which were then multiplied by estimated real-world densities from habitat-based density models (Roberts et al. 2016; 2023; 2024) to generate exposure estimates. The analysis of exposures and takes incidental to potential drilling as well as the requested take for this activity are discussed in the foundation installation section (Section 6.3). A summary of the potential UXO detonation impact analysis and exposure and take estimates as well as the requested take incidental to this activity are provided in Section 6.5. A summary of the cofferdam installation/removal impact analysis and exposure and take estimates as well as the requested take incidental to this activity are provided in Section 6.6.

6.1.1 Density-Based Take Estimates

As noted above, exposure estimates, whether derived from acoustic and animal movement modeling (impact pile driving and vibratory pile setting) or published (HRG surveys) or modeled (drilling, UXO, cofferdam installation/removal) acoustic ranges, relied on density estimates to reflect real-world animal occurrence. The marine mammal density estimates (animals/km^2) used in this assessment were obtained using the Duke University Marine Geospatial Ecological Laboratory (Duke/MGEL) Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016; 2023; 2024). The Duke/MGEL models provide mean monthly estimates of animals per 100 km^2 for each 5 x 5 km grid cell in the U.S. Atlantic and represent the number of animals that are expected to occur in the area in the absence of Vineyard Northeast activities. The densities used for each Vineyard Northeast activity are based on predicted areas of impact for each activity by creating a perimeter around the area where the activity will occur that is greater than or equal to the largest expected impact distance and taking the average of all grid cells overlapping (either partially or fully) with that area. Activity-specific densities are provided in the relevant subsections below.

The Roberts et al. (2016; 2023; 2024) density models provide densities for seals as a guild that includes both gray and harbor seals, as well as other phocid pinnipeds that are rare in the Offshore Development Area and for which no take is being requested, such as harp seals. To estimate density-based takes for the gray and harbor seal species individually, the seals' guild density was divided into species densities based on the proportions of these two species observed by PSOs within the Lease Area, OECCs, and surrounding areas during HRG site characterization surveys in 2019 and 2022–2023 (Geo SubSea LLC 2019, 2023; RPS 2024). There were 129 gray seals and 26 harbor seals sighted during these surveys, resulting in proportions of 0.832 and 0.168 for the two seal species, respectively. Similarly, the Roberts et al. (2016; 2023; 2024) density models provide densities for pilot whales as a guild that includes both short-finned and long-finned pilot whales. To estimate density-based takes for the two species individually, the pilot whales guild density was divided into species densities based on the proportions of the two species in seasonal abundance estimates for the RI/MA WEA study area from Appendix III of Palka et al. (2021), which are 0.80 for long-finned and 0.20 for short-finned pilot whales.

6.1.2 Level A Take

As noted in the introduction to Section 6, the only Vineyard Northeast activities anticipated to result in Level A take are foundation installation and UXO detonation. Level A take estimates incidental to these activities were calculated by rounding up Level A exposure estimates to an integer to reflect the number of animals that could be impacted. Although the analyses of foundation installation and UXO detonation show potential Level A take of North Atlantic right whales incidental to these activities, no Level A take is expected or being requested for this species. The Level A exposure estimates are conservative in that they assume no mitigation measures other than 10 dB of sound attenuation. However, the additional mitigation measures described in Section 11, including conservative temporal restrictions, robust and extensive visual and acoustic monitoring commitments, soft-start, and clearance/shutdown zones, when implemented in practice will reduce the already very low probability of Level A take for this species.

6.1.3 Level B Take

Similar to Level A take estimates, Level B take estimates were calculated by rounding up density-based Level B exposure estimates to an integer. In some cases, however, Protected Species Observer (PSO) data from HRG surveys can suggest that the presence of some species may be higher than that predicted by the available density estimates. Therefore, PSO data from the 2019 and 2022-2023 Vineyard Northeast site characterization surveys were also used to estimate potential Level B takes for all activities based on a daily sighting rate from PSO observations (as described in section 6.1.3.1). Lastly, if neither the density-based approach nor the PSO data-based approach resulted in a take estimate equal to or greater than the mean group size of a species, then one mean group size of that species was requested to account for the fact that many marine mammals tend to travel in groups and behavioral changes are therefore likely to affect the entire group rather than a single individual.

6.1.3.1 PSO Sightings Data-Based Level B Take Estimates

For some species, observational data from PSOs aboard survey vessels indicate that density-based take estimates may be insufficient to account for the number of individuals of a species that may be encountered during the planned activities. Therefore, PSO sighting data were used as described here to calculate a daily sighting rate which was then used for comparison with the density-based estimates of take. This comparison approach was taken for all activities (as shown in Sections 6.3–6.6) and species listed in Table 9. If the calculated PSO sightings data-based take estimate was larger than the density-based exposure estimate for a given species, the PSO sighting data-based take estimate was carried forward as the Level B take for the relevant project activity for the given year (as seen in Sections 6.3–6.6).

PSO data collected in 2019 and 2022–2023 during site characterization surveys of the Lease Area, OECCs, and surrounding waters (Geo SubSea LLC 2019, 2023; RPS 2024) were analyzed to determine the average number of individuals of each species observed per vessel day (Table 9). To account for individuals not identified to the species level by PSOs (i.e. those recorded as “unidentified whale,” “unidentified dolphin,” “unidentified seal,” etc.), the proportion of identified individuals of each species within each taxonomic group was calculated as shown in the column “Proportion of Total Individuals to Species Within Each Species Group” in Table 9. This value was then divided by the total number of vessel days (i.e., 815) during which observations were conducted during the three years of PSO sightings to calculate the number of individuals observed per vessel day as shown in the final column in Table 9. Vessel days is the sum of the number of days of observation for each vessel on which PSOs were making observations. This daily PSO sighting rate is then multiplied by the number of days of a given activity (e.g., for foundation installation Schedule A, year 3 [2030], this number was multiplied by 85, the number of days of piling that year) to arrive at PSO sighting data-based exposure and take estimates to be compared against the density-based exposure estimates.

Table 9. Number of marine mammals observed, by species, with and without inclusion of unidentified individuals, and the estimated number of individuals (including unidentified individuals) observed per vessel day during Vineyard Northeast 2019 and 2022–2023 site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024).

Species	Identified Individuals	Proportion of Total Individuals Identified to Species Within Each Species Group	Unidentified Individuals Assigned to Species	Total Individuals Including Proportion of Unidentified	Individuals Observed Per Vessel Day Including Unidentified
Mysticetes	**865**				
Fin whale*	222	0.26	52.6	274.6	0.34
Humpback whale	398	0.46	94.3	492.3	0.60
Minke whale	179	0.21	42.4	221.4	0.27
North Atlantic right whale*	23	0.03	5.5	28.5	0.03
Sei whale*	43	0.05	10.2	53.2	0.07
Unidentified Mysticetes					
Unidentified whales	205				
Dolphins	**18293**				
Atlantic spotted dolphin	10	0.00	0.7	10.7	0.01
Atlantic white-sided dolphin	27	0.00	1.8	28.8	0.04
Common bottlenose dolphin	1944	0.11	129.2	2073.2	2.54
Common dolphin	16300	0.89	1083.5	17383.5	21.33
Risso's dolphin	12	0.00	0.8	12.8	0.02
Unidentified Dolphins					
Unidentified dolphin	1216				
Pilot Whales	**3**				
Pilot whale, long-finned	3	1.00	234.0	237.0	0.29
Pilot whale, short-finned	0				
Unidentified Pilot whales					
Unidentifed pilot whales	234				
Pinnipeds	**155**				
Gray seal	129	0.83	11.7	140.7	0.17
Harbor seal	26	0.17	2.3	28.3	0.03
Unidentified Pinnipeds					
Unidentified seal	14				

* Indicates species listed as endangered under the US Endangered Species Act.

6.1.3.2 Mean Group Size-Based Level B Take Estimates

Density estimates inherently account for group size because the mean group size is a factor in the density estimate calculation. However, density surfaces, like those produced by Roberts et al.(2016; 2023; 2024), used to calculate mean densities in the impact areas, spread individuals out in space as if they did not occur in groups. When calculating takes, in cases where the Level B density-based exposure estimate was less than the average group size, it was assumed that if one group member were to be exposed, it is likely that all animals in the same group would receive a similar exposure level. In these cases, the requested Level B take is equal to one mean group size, rounded up to the nearest integer.

The Proponent is requesting Level B take for five marine mammal species considered to be rare (or extralimital) in the Offshore Development Area but which have been sighted during site characterization surveys or other studies. These species are the blue whale, killer whale, false killer whale, white-beaked dolphin, and gray whale. Because these animals are considered rare in this area, with densities that are effectively zero, no density-based take estimates were made. Instead, take for these species is based on group size. Table 10 provides the average marine mammal group sizes used in the take estimation. As a conservative measure, the larger of the AMAPPS or PSO data-based group size is used in take estimation. Not shown in Table 10 is the gray whale. Because this species is extralimital and has only been observed individually in recent years in the North Atlantic, a group size of one is used in the take estimation.

Table 10. Mean group sizes of marine mammal species for which take is being requested.

	PSO Data[a]	AMAPPS NE Survey Data	
Species	**Size**	**Size**	**Source[b]**
Mysticetes (LF hearing group)			
Blue whale*	-	1.0	AMAPPS annual reports
Fin whale*	2.0	1.2	Palka et al. (2021)
Humpback whale	2.2	1.3	Palka et al. (2021)
Minke whale	1.3	1.4	Palka et al. (2021)
North Atlantic right whale*	1.4	2.0	Table 6-5 of Palka et al. (2021)
Sei whale*	1.7	1.0	Palka et al. (2021)
Odontocetes (MF hearing group)			
Sperm whale*	-	2.0	Palka et al. (2021)
Atlantic spotted dolphin	10.0	24.0	AMAPPS[c]
Atlantic white-sided dolphin	9.0	19.1	Palka et al. (2021)
Common bottlenose dolphin	13.0	12.3	Palka et al. (2021)
Common dolphin	17.8	24.3	Palka et al. (2021)
False killer whale	5.0	7.1	Table 6-5 of Palka et al. (2021)
Killer whale	2.0	3.5	AMAPPS annual reports
Pilot whale, long-finned	3.0	6.2	Palka et al. (2021)
Pilot whale, short-finned	-	8.0	AMAPPS[c]
Risso's dolphin	12.0	1.8	Palka et al. (2021)
White-beaked dolphin	30.0	8.5	AMAPPS annual reports
Odontocetes (HF hearing group)			
Harbor porpoise	-	2.5	Palka et al. (2021)
Pinnipeds (PPW hearing group)			
Seals (gray and harbor)	1.1	1.4	Table 19-1 of Palka et al. (2017)

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data are from 2019 and 2022–2023 Vineyard Northeast site characterization surveys (Geo SubSea LLC 2019, 2023; RPS 2024) as well as surveys from a nearby lease area (Vineyard Wind 2019, 2021). For rare species (false killer whale, killer whale, white-beaked dolphin), group size is the maximum group size observed rather than the mean because there were so few sightings.

[b] Atlantic Marine Assessment Program for Protected Species (AMAPPS) data sources: Palka et al. (2021) is the average of the seasonal group sizes specific to the Rhode Island/Massachusetts Wind Energy Areas from Tables 2-2 through 2-5 of Appendix III of that report. AMAPPS annual reports are total number of individuals divided by total number of sightings from NE aerial and shipboard surveys from NEFSC and SEFSC (2011-2022).

[c] NMFS' recommended average group size estimate calculated from AMAPPS data.

6.2 Acoustic Thresholds

6.2.1 Level A Harassment Exposure Criteria

To assess potential auditory injury or permanent threshold shift (PTS), i.e., Level A harassment, resulting from impulsive sounds such as impact pile driving, UXO detonation, and some types of HRG survey equipment (e.g., deep seismic profilers), NMFS has provided technical guidance (NMFS 2018) that establishes dual criteria for five different marine mammal hearing groups, four of which occur in the Offshore Development Area (Table 11). These are based on measured or assumed values for the onset of temporary threshold shift (TTS) in marine mammals, which are also shown in Table 11. The two criteria are based on different acoustic metrics or ways of measuring sound – the peak sound pressure level (SPL_{pk}) and the cumulative sound exposure level (SEL_{cum}). The SPL_{pk} metric captures the potential for auditory injury caused by very intense, instantaneous sounds while the SEL_{cum} metric captures the potential for injury caused by fatiguing of the auditory system from sounds received over time (in this case, a maximum 24-hr period). NMFS (2018) also provides SPL_{pk} and SEL_{cum} PTS onset threshold criteria for non-impulsive sounds, such as those produced by drilling, vibratory hammering, and non-parametric sub-bottom profilers (i.e., CHIRP) that are used in HRG surveys. These are also shown in Table 11.

The marine mammal hearing groups are based on the frequencies of sound to which species in that group are most sensitive. The frequency-dependent hearing sensitivities of each group are characterized by frequency weighting functions that are applied to the sounds being modeled and represent the frequencies at which each hearing group is most susceptible to in terms of noise-induced hearing loss. Frequency weighting is applied when calculating distances to the SEL_{cum} threshold while SPL_{pk} is not frequency weighted and is commonly referred to as unweighted or flat-weighted (Table 11).

Table 11. NMFS (2018) PTS onset thresholds for impulsive sounds and non-impulsive sounds and TTS onset thresholds for impulsive sounds for the marine mammal functional hearing groups of species present in the Vineyard Northeast Offshore Development Area.

Marine Mammal Hearing Group	Generalized Hearing Range	PTS Onset Thresholds (Non-impulsive Sounds)	PTS Onset Thresholds (Impulsive Sounds)	TTS Onset Thresholds (Impulsive Sounds)
Low-frequency cetaceans (LF)	7 Hz to 35 kHz	$L_{E,p,LF,24h}$: 199 dB	$L_{p,0\text{-}pk,flat}$: 219 dB $L_{E,p,LF,24h}$: 183 dB	$L_{p,0\text{-}pk,flat}$: 213 dB $L_{E,p,LF,24h}$: 168 dB
Mid-frequency cetaceans (MF)	150 Hz to 160 kHz	$L_{E,p,MF,24h}$: 198 dB	$L_{p,0\text{-}pk,flat}$: 230 dB $L_{E,p,MF,24h}$: 185 dB	$L_{p,0\text{-}pk,flat}$: 224 dB $L_{E,p,MF,24h}$: 170 dB
High-frequency cetaceans (HF)	275 Hz to 160 kHz	$L_{E,p,HF,24h}$: 173 dB	$L_{p,0\text{-}pk,flat}$: 202 dB $L_{E,p,HF,24h}$: 155 dB	$L_{p,0\text{-}pk,flat}$: 196 dB $L_{E,p,HF,24h}$: 140 dB
Phocid pinnipeds (underwater) (PW)	50 Hz to 86 kHz	$L_{E,p,PW,24h}$: 201 dB	$L_{p,0\text{-}pk,flat}$: 218 dB $L_{E,p,PW,24h}$: 185 dB	$L_{p,0\text{-}pk,flat}$: 212 dB $L_{E,p,PW,24h}$: 170 dB

PTS onset thresholds for impulsive sounds are used to define Level A harassment for impact piling, UXO detonation, and some HRG equipment. PTS onset thresholds for non-impulsive sounds are used to define Level A harassment for drilling, vibratory hammering, and non-impulsive HRG equipment. TTS onset thresholds for impulsive sounds are used to define Level B harassment for UXO detonation.

Peak sound pressure level (L_p) is in units of dB re 1 µPa and cumulative sound exposure level ($L_{E,24h}$) is in units of dB re 1 $\mu Pa^2 \cdot s$.

Scientific recommendations for revisions to these classifications were published by Southall et al. (2019). This publication proposes a new nomenclature and classification for the marine mammal hearing groups, but the proposed thresholds and weighting functions do not differ in effect from those in NMFS (2018). Subsequent to the initial submission of this application in May 2024, NMFS developed and published updated criteria for onset of acoustic injury (PTS) and TTS (NMFS 2024g) that include the new nomenclature proposed by Southall et al. (2019). Additionally, some thresholds have been updated in NMFS' Updated Technical Guidance (NMFS 2024g). The updated thresholds and corresponding exposure estimates as well as acoustic and exposure ranges are included in Appendix A, and alternate take estimates and monitoring zones using these updated thresholds are provided in Appendix B. The take request in this document, however, uses the NMFS (2018) thresholds that were applicable at the time of application submission.

For potential UXO detonations, in addition to the PTS and TTS onset thresholds shown in Table 11, thresholds for mortality and non-auditory injury to lung and gastrointestinal organs from the blast shock wave and/or onset of high peak pressures are also relevant (at relatively close ranges). These criteria have been developed by the U.S. Navy (DoN 2017) and are based on the mass of the animal and the depth at which it is present in the water column. This means that specific decibel levels for each hearing group are not provided and instead the criteria are presented as equations that allow for incorporation of specific mass and depth values. A conservative equation is available reflecting the onset (1% chance) of experiencing the potential effects (Table 12). The results from the equations in Table 12 were used in the subsequent analysis.

Table 12. U.S. Navy impulse and peak pressure threshold equations for estimating at what levels marine mammals have a 1% probability of experiencing mortality or non-auditory injury due to underwater explosions (DoN 2017). *M* is animal mass in kilograms and *D* is animal depth in meters.

Effects assessment criterion	Metric	Threshold
Onset mortality (impulse)	Acoustic impulse (J_p)	$103\,M^{1/3}\left(1+\frac{D}{10}\right)^{1/6}$ Pa·s
Onset non-auditory injury (impulse)	Acoustic impulse (J_p)	$47.5\,M^{1/3}\left(1+\frac{D}{10}\right)^{1/6}$ Pa·s
Onset non-auditory injury (peak pressure)	Unweighted peak compressional pressure level (L_{pk})	237 dB re 1 μPa peak

6.2.2 Level B Harassment Exposure Criteria

The received level at which marine mammals may behaviorally respond to anthropogenic sounds varies by numerous factors including the frequency content, predictability, and duty cycle of the sound as well as the experience, demography, and behavioral state of the marine mammals (Richardson et al. 1995; Southall et al. 2007; Ellison et al. 2012). Despite this variability, there is a practical need for a reasonable and specific threshold. NMFS currently defines the threshold for behavioral harassment, Level B take, as 160 dB re 1 µPa SPL_{rms} for impulsive or intermittent sounds such as those produced by impact pile driving and some HRG survey equipment. For continuous sounds, such as those produced by vibratory hammering (used for pile setting or cofferdam installation/removal) or drilling, NMFS defines the threshold for behavioral harassment at 120 dB re 1 µPa SPL_{rms}.

A single UXO detonation per day is not considered to cause behavioral harassment if received sound levels are below the temporary threshold shift (TTS) onset thresholds. Level B harassment is considered possible if received sounds from a single UXO detonation per day are above these levels, or if they are above 5 dB below the TTS thresholds in the event of multiple detonations in one day. Because only a single detonation per day is being considered, sub-TTS threshold behavioral harassment is not expected to occur. As with the PTS onset levels used to define Level A take thresholds, TTS criteria use both SPL_{pk} and SEL_{cum} criteria as shown in Table 11.

6.3 WTG and ESP/Booster Station Foundation Installation

As described in Section 1, WTGs will be installed on either monopile or piled jacket foundations and it was assumed that the ESPs and the booster station will be installed on piled jacket foundations.[9] All foundations will require impact pile driving during installation; in some cases, vibratory pile setting and potentially drilling could also be required. To estimate impacts from pile driving during foundation installation, an acoustic and animal movement modeling study was conducted for Vineyard Northeast (Appendix A). That study established acoustic and exposure ranges to marine mammal sound exposure thresholds as well as estimates of the number of animals exposed to sound above these thresholds to inform take estimation and monitoring and mitigation. Acoustic ranges ($R_{95\%}$) are the predicted ranges from the sound source that encompass at least 95% of the area that would be exposed to sound at or above the specified level. Exposure range ($ER_{95\%}$) is the horizontal distance from a sound source that includes 95% of the closest points of approach (CPAs) of simulated animats whose sound exposure exceeds that of a given threshold, and therefore incorporate the realistic behavior of the modeled animals. To assess potential impacts of drilling that may be required during foundation installation, the study included acoustic modeling and density-based exposure estimates (rather than animat modeling) for this activity (Appendix I of Appendix A). Complete details and results of the modeling of foundation installation can be found in Appendix A. A summary of the methods and results is provided here.

Acoustic modeling predicts sound fields resulting from various sound sources. For impact pile driving, the model includes input parameters such as pile size, penetration depth, hammer size, number of strikes at different hammer energies, and strike rate. For vibratory hammering, the duration, rather than strike rate and number of strikes, is used. The acoustic modeling output, which includes various sound fields for the different modeled scenarios, is then used as input to the animal movement (exposure) modeling. Exposure modeling provides marine mammal sound exposure estimates that incorporate species-specific behaviors like dive depth and duration as well as surface times. Seven-day simulations are run for each combination of species, foundation type, number installed per day, exposure modeling location, sound source, and sound attenuation level. During the simulation, the animats move around within the simulation area (that includes the acoustically modeled sound field) based on parameters defined by the real-world behavior of each species from scientific studies, and the sound experienced by each animat is recorded. When more than one sound source is present during a 24-hour period, such as when impact pile driving is preceded by vibratory pile setting, JASCO considers the combined sound energy of these two sources when calculating the cumulative SEL. The result of the simulation is a 24-hour sound exposure profile for each animat for seven days. In model post-processing, the seven-day

[9] The ESP(s) and booster station will be installed on monopiles or piled jacket foundations. For the purpose of impact analyses, it was conservatively assumed that the ESP(s) and booster station will be installed on piled jacket foundations.

average number of animats exceeding each sound exposure threshold is then calculated for each simulation. For cases when impact pile driving is preceded by vibratory pile setting, the JASCO exposure model applies the PTS onset (i.e., Level A) thresholds for the impulsive sounds of impact pile driving to the combined sound energy from the two sound sources, for conservatism, because the PTS onset thresholds are lower for the impulsive sound of impact piling than for the non-impulsive sound of vibratory piling. This seven-day average number of animats exceeding the sound threshold is then multiplied by the average monthly marine mammal densities in the impact area to obtain an estimate of potential real-world marine mammal exposures per day in a given month. These daily marine mammal exposures, which are specific to the month when the sound exposure occurs, are then multiplied by the number of days of sound exposure in that month. The number of days per month is based on the proposed foundation installation schedules (see below). Finally, the monthly exposures are summed to obtain modeled exposure estimates for each species for each year and each potential foundation installation schedule, which is the final result of the exposure modeling.

6.3.1 Assumptions Used in the Impact Analysis

The acoustic modeling assumed several potential scenarios consisting of different combinations of pile types, hammer sizes and types (impact or vibratory), energy levels, number of strikes at each energy level, strike rate, and duration of impact and vibratory hammering per pile. These are summarized in Table 13. The scenarios in Table 13 are referred to using the terminology from the acoustic modeling report (Appendix A) wherein impact only scenario names start with the letter "A" followed by a number, and the corresponding impact plus vibratory scenario name starts with the letters "AV." Additional details on each of the scenarios can be found in Section 1.2.1 of Appendix A. The location and pile size determine what energy will be used for each foundation. Foundations are designed for site-specific conditions and the final foundation diameters will vary across the site and depend upon final WTG selection. Larger monopiles would require larger hammer energies compared to smaller monopiles. Additionally, site-specific geologic conditions inform the anticipated hammer energy required.

As noted in Section 2, the impact analysis assumed two different potential schedules for foundation installation – Schedule A, a two-year schedule, and Schedule B, a four-year schedule. The two schedules are intended to represent the range of potential construction schedule scenarios. Schedule A represents a schedule where the WTGs and associated monopiles may be smaller and a hammer energy of 6,600 or 8,000 kJ could be used (depending on the site-specific geological conditions at each position). Schedule B represents a schedule where the WTGs and associated monopiles may be larger and a hammer energy of 8,000 kJ would be used. Schedule A assumes foundations would be installed during years 3 and 4 (2030 and 2031) of the requested authorization, and Schedule B assumes foundations would be installed during years 2–5 (2029–2032) of the requested authorization. Detailed foundation installation schedules for the full buildout of Vineyard Northeast are presented in Section 6.3.1.1.

As noted above, Vineyard Northeast will be split into Project 1 and Project 2 approximately evenly between the northeastern and southwestern halves of the Lease Area in terms of foundation positions. Project 1 will be installed during years 3 and 4 (2030 and 2031) under Schedule A or during years 2 and 3 (2029 and 2030) under Schedule B, as further described in Section 6.3.1.2. Project 2 will be installed during years 3 and 4 (2030 and 2031) under Schedule A and during years 4 and 5 (2031 and 2032) under Schedule B, as further described in Section 6.3.1.3. Table 13 indicates which of the acoustically modeled scenarios are planned to be used for the full buildout as well as Project 1 and Project 2 for each schedule and each year.

There is an overlap area of 10 foundation positions that could be allotted to either Project 1 or Project 2. To ensure that adequate take was requested for each project, the maximum case was assumed for each. That is, the exposure and take estimates for both projects include all foundation positions in the overlap area. However, if these foundations are installed for one project, then the actual take will be lower for the other project. Thus, the sum of the estimated take for the two projects is greater than the estimated take for the full buildout. The realistic full buildout scenario is used in the total take request.

Table 13. Number of impact piling strikes, strike rate, and duration of impact piling (per pile) for each of the acoustically modeled scenarios and list of schedules, projects, and years during which each of these scenarios is planned to be used.

	14 m Monopile Max. Hammer Energy 6600 kJ				**14 m Difficult-to-Drive Monopile Max. Hammer Energy: 6600 kJ**				**14 m Monopile Max. Hammer Energy: 8000 kJ**				**4.25 m Pin Pile Max. Hammer Energy: 3500**	
	Impact Only Scenario A3		**Vib & Impact Scenario AV3**		**Impact Only Scenario A2**		**Vib & Impact Scenario AV2**		**Impact Only Scenario A1**		**Vib & Impact Scenario AV1**		**Impact Only Scenarios A6, A7, and A8**	
	Energy Level (kJ)	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**	**Energy Level (kJ)**	**Number of strikes**
	2200	915	3500	260	3500	2169	3500	896	3500	2169	3500	896	500	1400
	3500	780	6600	4606	6600	6917	6600	6917	8000	6917	8000	6917	1000	2000
	6600	4606											1500	2000
													2000	2000
													3000	2000
													3500	6000
Total strikes		**6301**		**4866**		**9086**		**7813**		**9086**		**7813**		**15400**
Modeled strike rate (strikes per minute)		**30**		**30**		**30**		**30**		**30**		**30**		**33 (3 per day) 44 (4 per day)**
Duration of impact piling (hours per pile)		**3.50**		**2.70**		**5.05**		**4.34**		**5.05**		**4.34**		**7.8 (3 per day) 5.8 (4 per day)**
Duration of vibratory setting (min per pile)		**NA**		**30**		**NA**		**60**		**NA**		**60**	**NA**	**NA**
Schedule A	Full buildout, year 3 Project 1, year 3 Project 2, year 3		Full buildout, year 4 Project 1, year 4 Project 2, year 4		Full buildout, year 3 Project 1, year 3		Full buildout, year 4 Project 2, year 4		Full buildout, year 3 Project 1, year 3 Project 2, year 3				Full buildout, year 3 Full buildout, year 4 Project 1, year 3 Project 2, year 4	
Used in Schedule B	No		No		No		No		Full buildout, year 2 Full buildout, year 3 Project 1, year 2 Project 1, year 3 Project 2, year 4		Full buildout, year 4 Project 1, year 3 Project 2, year 4		All projects, all years	

The primary assumptions used in the acoustic and exposure modeling study for the two potential construction schedules for the full buildout of Vineyard Northeast as well as for Project 1 and Project 2 are shown in Tables 14 through 19. Additional details can be found in Appendix A.

Table 14. Schedule A, Full Buildout: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 3 (2030)		Year 4 (2031)		
	WTG Monopiles	**ESP Jackets**	**WTG Monopiles**	**WTG Jackets**	**ESP Jackets**
Number of foundations	79	2	51	27	2
Piles per foundation	1	18	1	3 and 4	18
Pile diameter (m)	14	4.25	14	4.25	4.25
Max. expected penetration depth (m)	45	80	45	80	80
Maximum hammer energy[a] (kJ)	6600 and 8000	3500	6600	3500	3500
Impact or vibratory	Impact	Impact	Both	Impact	Impact
Max. impact piling strikes per pile[a]	6301 and 9086	15,400	4866 and 7813	15,400	15,400
Duration of impact piling (hrs per pile)	3.50 and 5.05	5.83	2.70 and 4.34	7.78 and 5.83	5.83
Duration of impact piling (hrs per day)[b]	3.50 and 5.05 and 7.00	23.33	2.70 and 4.34 and 5.40	23.33	23.33
Duration of vibrohammering (min)	NA	NA	30 and 60[c]	NA	NA
Number of days with drilling	0	0	5	0	0
Piles per day	1 and 2	4	1 and 2	3 and 4	4
Total pile installation days	76	9	43	27	9
Assumed installation months	Jun – Nov	Aug – Sep	Jun – Nov	Aug – Sep	Aug – Sep

[a] Not all monopile scenarios used the maximum hammer energy nor maximum number of impact piling strikes. See Table 13 for scenario details.

[b] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

[c] The Proponent's drivability analysis suggested that some foundations may be more difficult to drive (DTD) than is typical for the Offshore Development Area. The modeling assumed 30 minutes of vibratory pile setting for monopiles with typical drivability using a max hammer energy of 6600 kJ, and 60 minutes of vibratory pile setting was assumed for DTD monopiles using a maximum hammer energy of 6600 kJ and for monopiles requiring a maximum hammer energy of 8000 kJ.

Table 15. Schedule A, Project 1: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 3 (2030)		Year 4 (2031)		
	WTG Monopiles	ESP Jackets	WTG Monopiles	WTG Jackets	ESP Jackets
Number of foundations	79	2	5	-	-
Piles per foundation	1	18	1	-	-
Pile diameter (m)	14	4.25	14	-	-
Max. expected penetration depth (m)	45	80	45	-	-
Maximum hammer energy[a] (kJ)	6600 and 8000	3500	6600	-	-
Impact or vibratory	Impact	Impact	Both	-	-
Max. impact piling strikes per pile[a]	6301 and 9086	15,400	4,866	-	-
Duration of impact piling (hrs per pile)	3.50 and 5.05	5.83	2.70	-	-
Duration of impact piling (hrs per day)[b]	3.50 and 5.05 and 7.00	23.33	2.70		
Duration of vibrohammering (min)	NA	NA	30	-	-
Number of days with drilling	0	0	0	-	-
Piles per day	1 and 2	4	1	-	-
Total pile installation days	76	9	5	-	-
Assumed installation months	Jun – Nov	Aug – Sep	Jun – Jul	-	-

[a] Not all monopile scenarios used the maximum hammer energy nor maximum number of impact piling strikes. See Table 13 for scenario details.

[b] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

Table 16. Schedule A, Project 2: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 3 (2030)		Year 4 (2031)		
	WTG Monopiles	ESP Jackets	WTG Monopiles	WTG Jackets	ESP Jackets
Number of foundations	5	-	51	27	2
Piles per foundation	1	-	1	3 and 4	18
Pile diameter (m)	14	-	14	4.25	4.25
Max. expected penetration depth (m)	45	-	45	80	80
Maximum hammer energy[a] (kJ)	6600 and 8000	-	6600	3500	3500
Impact or vibratory	Impact	-	Both	Impact	Impact
Max. impact piling strikes per pile[a]	6301 and 9086	-	4866 and 7813	15,400	15,400
Duration of impact piling (hrs per pile)	3.50 and 5.05	-	2.70 and 4.34	7.78 and 5.83	5.83
Duration of impact piling (hrs per day)[b]	3.50 and 5.05		2.70 and 4.34 and 5.40	23.33	23.33
Duration of vibrohammering (min)	NA	-	30 and 60[c]	NA	NA
Number of days with drilling	0	-	5	0	0
Piles per day	1	-	1 and 2	3 and 4	4
Total pile installation days	5	-	43	27	9
Assumed installation months	Sep – Nov	-	Jun – Nov	Aug – Sep	Aug – Sep

[a] Not all monopile scenarios used the maximum hammer energy nor maximum number of impact piling strikes. See Table 13 for scenario details.

[b] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

[c] The Proponent's drivability analysis suggested that some foundations may be more difficult to drive (DTD) than is typical for the Offshore Development Area. The modeling assumed 30 minutes of vibratory pile setting for monopiles with typical drivability using a max hammer energy of 6600 kJ, and 60 minutes of vibratory pile setting was assumed for DTD monopiles using a maximum hammer energy of 6600 kJ and for monopiles requiring a maximum hammer energy of 8000 kJ.

Table 17. Schedule B, Full Buildout: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 2 (2029)		Year 3 (2030)		Year 4 (2031)			Year 5 (2032)	
	WTG Monopiles	ESP Jackets	WTG Monopiles	ESP Jackets	WTG Monopiles	WTG Jackets	ESP Jackets	WTG Jackets	ESP Jackets
Number of foundations	40	1	39	1	18	21	1	39	1
Piles per foundation	1	18	1	18	1	4	18	4	18
Pile diameter (m)	14	4.25	14	4.25	14	4.25	4.25	4.25	4.25
Max. expected penetration depth (m)	45	80	45	80	45	80	80	80	80
Maximum hammer energy (kJ)	8000	3500	8000	3500	8000	3500	3500	3500	3500
Impact or vibratory	Impact	Impact	Impact	Impact	Both	Impact	Impact	Impact	Impact
Max. impact piling strikes per pile	9,086	15,400	9,086	15,400	7,813	15,400	15,400	15,400	15,400
Duration of impact piling (hrs per pile)	5.05	5.83	5.05	5.83	4.34	5.83	5.83	5.83	5.83
Duration of impact piling (hrs per day)[a]	5.05 and 10.10	23.33	5.05 and 10.10	23.33	4.34	23.33	23.33	23.33	23.33
Duration of vibrohammering (min)	NA	NA	NA	NA	60	NA	NA	NA	NA
Number of days with drilling	0	0	0	0	5	0	0	0	0
Piles per day	1 and 2	4	1 and 2	4	1	4	4	4	4
Total pile installation days	37	5	36	5	18	21	5	39	5
Assumed installation months	Jun – Nov	Aug	Jun – Nov	Aug	Jun – Jul	Aug – Nov	Aug	Jun– Nov	Aug

[a] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

Table 18. Schedule B, Project 1: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 2 (2029)		Year 3 (2030)		Year 4 (2031)			Year 5 (2032)	
	WTG Monopiles	**ESP Jackets**	**WTG Monopiles**	**ESP Jackets**	**WTG Monopiles**	**WTG Jackets**	**ESP Jackets**	**WTG Jackets**	**ESP Jackets**
Number of foundations	40	1	44	1	-	-	-	-	-
Piles per foundation	1	18	1	18	-	-	-	-	-
Pile diameter (m)	14	4.25	14	4.25	-	-	-	-	-
Max. expected penetration depth (m)	45	80	45	80	-	-	-	-	-
Maximum hammer energy (kJ)	8000	3500	8000	3500	-	-	-	-	-
Impact or vibratory	Impact	Impact	Both	Impact	-	-	-	-	-
Max. impact piling strikes per pile	9,086	15,400	9,086	15,400	-	-	-	-	-
Duration of impact piling (hrs per pile)	5.05	5.83	4.34 and 5.05	5.83	-	-	-	-	-
Duration of impact piling (hrs per day)[a]	5.05 and 10.10	23.33	4.34 and 5.05 and 10.10	23.33	-	-	-	-	-
Duration of vibrohammering (min)	NA	NA	NA	NA	-	-	-	-	-
Number of days with drilling	0	0	0	0	-	-	-	-	-
Piles per day	1 and 2	4	1 and 2	4	-	-	-	-	-
Total pile installation days	37	5	41	5	-	-	-	-	-
Assumed installation months	Jun – Nov	Aug	Jun – Nov	Aug	-	-	-	-	-

[a] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

Table 19. Schedule B, Project 2: Assumptions used in the acoustic and exposure modeling study for wind turbine generator (WTG) and electrical service platform (ESP)/booster station foundation installation.

	Year 2 (2029)		Year 3 (2030)		Year 4 (2031)			Year 5 (2032)	
	WTG Monopiles	ESP Jackets	WTG Monopiles	ESP Jackets	WTG Monopiles	WTG Jackets	ESP Jackets	WTG Jackets	ESP Jackets
Number of foundations	-	-	-	-	23	21	1	39	1
Piles per foundation	-	-	-	-	1	4	18	4	18
Pile diameter (m)	-	-	-	-	14	4.25	4.25	4.25	4.25
Max. expected penetration depth (m)	-	-	-	-	45	80	80	80	80
Maximum hammer energy (kJ)	-	-	-	-	8000	3500	3500	3500	3500
Impact or vibratory	-	-	-	-	Both	Impact	Impact	Impact	Impact
Max. impact piling strikes per pile	-	-	-	-	7813 and 9086	15,400	15,400	15,400	15,400
Duration of impact piling (hrs per pile)	-	-	-	-	4.34 and 5.05	5.83	5.83	5.83	5.83
Duration of impact piling (hrs per day)[a]					4.34 and 5.05	23.33	23.33	23.33	23.33
Duration of vibrohammering (min)	-	-	-	-	60	NA	NA	NA	NA
Number of days with drilling	-	-	-	-	5	0	0	0	0
Piles per day	-	-	-	-	1	4	4	4	4
Total pile installation days	-	-	-	-	23	21	5	39	5
Assumed installation months	-	-	-	-	Jun – Jul	Aug – Nov	Aug	Jun– Nov	Aug

[a] Duration of impact piling per day includes the number of piles installed per day. The longest duration shown is for installation of two piles per day for monopiles. For jacket pin piles, the modeling assumed a higher strike would be used to install four piles per day, versus three piles per day (see Table 13), thus the total duration of piling per day is the same whether three or four piles are installed. The modeling is conservative in that it assumed the highest number of strikes within a 24-hour period; however, it is likely that most jackets can be installed in fewer than 23.3 hours of impact pile driving.

6.3.1.1 *Foundation Installation Schedules – Vineyard Northeast Full Buildout*

The numbers and types of foundations to be installed each month and in each year of the two proposed schedules for the full buildout of Vineyard Northeast are shown in Table 20 through Table 25. Note that, for installation Schedule B, there is an estimated five days of piling each year to install ESP/booster station jacket foundations. The modeling assumed four post-piled jacket piles per day, so the results are for 20 pin piles installed during those five days. However, because the ESP/booster station jacket foundations have only 18 pin piles, on one of those five days, only two piles (rather than four) will be installed. The result is a small overestimation of the potential Level A harassment, which is based on the cumulative sound exposure, but would have minimal or no impact on the estimated Level B harassment.

Table 20. Foundation installation schedule for Full Buildout, Schedule A (impact pile driving only), year 3 (2030).

	WTG Monopile (MP) Impact Only (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 6600 kJ 1 pile/day	14 m MP 6600 kJ 2 piles/day	14 m DTD MP 6600 kJ 1 pile/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 3 piles/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0	0	0
June	**3**	0	0	0	0	0	0	**3**	0	**3**
July	**14**	0	**8**	**4**	0	0	0	**26**	0	**26**
August	**15**	**1**	0	**6**	0	0	**4**	**23**	**16**	**26**
September	**10**	**2**	**4**	**5**	0	0	**5**	**23**	**20**	**26**
October	**3**	0	0	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0	0	0
Total Days	**46**	**3**	**12**	**15**	0	0	**9**	**79**	**36**	**85**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 21. Foundation installation schedule for Full Buildout, Schedule A (impact pile driving and vibratory pile setting followed by impact pile driving), year 4 (2031).

	WTG Monopile (MP) Vibratory & Impact (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Imapct Only (Days)	Yearly Totals		
Month	14 m MP 6600 kJ 1 pile/day	14 m MP 6600 kJ 2 piles/day	14 m DTD MP 6600 kJ 1 pile/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 3 piles/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0	0	0
June	**1**	0	0	0	0	0	0	**1**	0	**1**
July	**9**	**4**	0	0	0	0	0	**17**	0	**13**
August	0	0	0	0	**14**	**12**	**5**	0	**110**	**31**
September	**9**	**4**	**12**	0	**1**	0	**4**	**29**	**19**	**30**
October	**3**	0	0	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0	0	0
Total	**23**	**8**	**12**	**0**	**15**	**12**	**9**	**51**	**129**	**79**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 22. Foundation installation schedule for Full Buildout, Schedule B (impact pile driving only), year 2 (2029).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	**3**	0	0	0	0	**3**	0	**3**
July	**12**	0	0	0	0	**12**	0	**12**
August	**11**	**1**	0	0	**5**	**13**	**20**	**17**
September	**4**	**2**	0	0	0	**8**	0	**6**
October	**3**	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0
Total	**34**	**3**	**0**	**0**	**5**	**40**	**20**	**42**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 23. Foundation installation schedule for Full Buildout, Schedule B (impact pile driving only), year 3 (2030).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Imapct Only (Days)	ESP Jacket Imapact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	**3**	0	0	0	0	**3**	0	**3**
July	**12**	0	0	0	0	**12**	0	**12**
August	**11**	**1**	0	0	**5**	**13**	**20**	**17**
September	**4**	**2**	0	0	0	**8**	0	**6**
October	**2**	0	0	0	0	**2**	0	**2**
November	**1**	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0
Total	**33**	**3**	0	0	**5**	**39**	**20**	**41**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 24. Foundation installation schedule for Full Buildout, Schedule B (impact and vibratory pile driving), year 4 (2031).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	0	0	**9**	0	0	**9**	0	**9**
July	0	0	**9**	0	0	**9**	0	**9**
August	0	0	0	**8**	**5**	0	**52**	**13**
September	0	0	0	**10**	0	0	**40**	**10**
October	0	0	0	**2**	0	0	**8**	**2**
November	0	0	0	**1**	0	0	**4**	**1**
December	0	0	0	0	0	0	0	0
Total	0	0	**18**	**21**	**5**	**18**	**104**	**44**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 25. Foundation installation schedule for Full Buildout, Schedule B (impact pile driving only), year 5 (2032).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	0	0	0	**2**	0	0	**8**	**2**
July	0	0	0	**10**	0	0	**40**	**10**
August	0	0	0	**15**	**5**	0	**80**	**20**
September	0	0	0	**9**	0	0	**36**	**9**
October	0	0	0	**2**	0	0	**8**	**2**
November	0	0	0	**1**	0	0	**4**	**1**
December	0	0	0	0	0	0	0	0
Total	0	0	0	**39**	**5**	0	**176**	**44**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

6.3.1.2 Foundation Installation Schedules – Project 1

Table 26 through Table 29 show the numbers and types of foundations to be installed each month and in each year of the two proposed schedules used in the exposure and take estimation for Project 1.

Table 26. Foundation installation schedule for Project 1, Schedule A (impact pile driving only), Year 3 (2030).

	WTG Monopile (MP) Impact Only (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 6600 kJ 1 pile/day	14 m MP 6600 kJ 2 piles/day	14 m DTD MP 6600 kJ 1 pile/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 3 piles/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0	0	0
June	**3**	0	0	0	0	0	0	**3**	0	**3**
July	**14**	0	**8**	**4**	0	0	0	**26**	0	**26**
August	**15**	**1**	0	**6**	0	0	**4**	**23**	**16**	**26**
September	**10**	**2**	**4**	**5**	0	0	**5**	**23**	**20**	**26**
October	**3**	0	0	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0	0	0
Total Days	**46**	**3**	**12**	**15**	0	0	**9**	**79**	**36**	**85**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 27. Foundation installation schedule for Project 1, Schedule A (impact and vibratory pile driving), year 4 (2031).

Month	WTG Monopile (MP) Vibratory & Impact (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Impact Only (Days)	Yearly Totals		
	14 m MP 6600 kJ 1 pile/day	14 m MP 6600 kJ 2 piles/day	14 m DTD MP 6600 kJ 1 pile/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 3 piles/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0	0	0
June	**1**	0	0	0	0	0	0	**1**	0	**1**
July	**4**	0	0	0	0	0	0	**4**	0	**4**
August	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
Total Days	**5**	0	0	0	0	0	0	**5**	0	**5**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 28. Foundation installation schedule for Project 1, Schedule B (impact pile driving only), year 2 (2029).

Month	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	**3**	0	0	0	0	**3**	0	**3**
July	**12**	0	0	0	0	**12**	0	**12**
August	**11**	**1**	0	0	**5**	**13**	**20**	**17**
September	**4**	**2**	0	0	0	**8**	0	**6**
October	**3**	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0
Total	**34**	**3**	0	0	**5**	**40**	**20**	**42**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 29. Foundation installation schedule for Project 1, Schedule B (impact and vibratory pile driving), year 3 (2030).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	**3**	0	**5**	0	0	**8**	0	**8**
July	**12**	0	0	0	0	**12**	0	**12**
August	**11**	**1**	0	0	**5**	**13**	**20**	**17**
September	**4**	**2**	0	0	0	**8**	0	**6**
October	**2**	0	0	0	0	**2**	0	**2**
November	**1**	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0
Total	**33**	**3**	**5**	**0**	**5**	**44**	**20**	**46**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

6.3.1.3 Foundation Installation Schedules – Project 2

Table 30 through Table 33 show the numbers and types of foundations to be installed each month and in each year of the two proposed schedules used in the exposure and take estimation for Project 2.

Table 30. Foundation installation schedule for Project 2, Schedule A (impact pile driving only), year 3 (2030).

	WTG Monopile (MP) Impact Only (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 6600 kJ 1 pile/day	14 m MP 6600 kJ 2 piles/day	14 m DTD MP 6600 kJ 1 pile/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 3 piles/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0	0	0	0
September	0	0	0	**1**	0	0	0	**1**	0	**1**
October	**3**	0	0	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0	0	0
Total Days	**4**	0	0	**1**	0	0	0	**5**	0	**5**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 31. Foundation installation schedule for Project 2, Schedule A (impact and vibratory pile driving), year 4 (2031).

	WTG Monopile (MP) Vibratory & Impact (Days)				WTG Jacket Impact Only (Days)		ESP Jacket Imapct Only (Days)	Yearly Totals		
Month	**14 m MP 6600 kJ 1 pile/day**	**14 m MP 6600 kJ 2 piles/day**	**14 m DTD MP 6600 kJ 1 pile/day**	**14 m MP 8000 kJ 1 pile/day**	**4.25 m Pre-piled Pin pile 3 piles/day**	**4.25 m Pre-piled Pin pile 4 piles/day**	**4.25 m Post-piled Pin pile 4 piles/day**	**Total number of monopiles**	**Total number of pin piles**	**Total number of days**
May	0	0	0	0	0	0	0	0	0	0
June	**1**	0	0	0	0	0	0	**1**	0	**1**
July	**9**	**4**	0	0	0	0	0	**17**	0	**13**
August	0	0	0	0	**14**	**12**	**5**	0	**110**	**31**
September	**9**	**4**	**12**	0	**1**	0	**4**	**29**	**19**	**30**
October	**3**	0	0	0	0	0	0	**3**	0	**3**
November	**1**	0	0	0	0	0	0	**1**	0	**1**
December	0	0	0	0	0	0	0	0	0	0
Total	**23**	**8**	**12**	0	**15**	**12**	**9**	**51**	**129**	**79**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]), DTD = difficult to drive. DTD indicates that a drivability analysis suggested that higher hammer energies or more strikes may be required at some locations.

Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 32. Foundation installation schedule for Project 2, Schedule B (impact and vibratory pile driving), year 4 (2031).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	**14 m MP 8000 kJ 1 pile/day**	**14 m MP 8000 kJ 2 piles/day**	**14 m MP 8000 kJ 1 pile/day**	**4.25 m Pre-piled Pin pile 4 piles/day**	**4.25 m Post-piled Pin pile 4 piles/day**	**Total number of monopiles**	**Total number of pin piles**	**Total number of days**
May	0	0	0	0	0	0	0	0
June	**3**	0	**9**	0	0	**12**	0	**12**
July	**2**	0	**9**	0	0	**11**	0	**11**
August	0	0	0	**8**	**5**	0	**52**	**13**
September	0	0	0	**10**	0	0	**40**	**10**
October	0	0	0	**2**	0	0	**8**	**2**
November	0	0	0	**1**	0	0	**4**	**1**
December	0	0	0	0	0	0	0	0
Total	**5**	0	**18**	**21**	**5**	**23**	**104**	**49**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).

Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

Table 33. Foundation installation schedule for Project 2, Schedule B (impact pile driving only), year 5 (2032).

	WTG Monopile (MP) Impact Only (Days)		WTG Monopile (MP) Vib & Impact (Days)	WTG Jacket Impact Only (Days)	ESP Jacket Impact Only (Days)	Yearly Totals		
Month	14 m MP 8000 kJ 1 pile/day	14 m MP 8000 kJ 2 piles/day	14 m MP 8000 kJ 1 pile/day	4.25 m Pre-piled Pin pile 4 piles/day	4.25 m Post-piled Pin pile 4 piles/day	Total number of monopiles	Total number of pin piles	Total number of days
May	0	0	0	0	0	0	0	0
June	0	0	0	**2**	0	0	**8**	**2**
July	0	0	0	**10**	0	0	**40**	**10**
August	0	0	0	**15**	**5**	0	**80**	**20**
September	0	0	0	**9**	0	0	**36**	**9**
October	0	0	0	**2**	0	0	**8**	**2**
November	0	0	0	**1**	0	0	**4**	**1**
December	0	0	0	0	0	0	0	0
Total	0	0	0	**39**	**5**	0	**176**	**44**

WTG = wind turbine generator, ESP = electrical service platform or booster station (the PDE for the booster station jacket structure pin piles is the same as the ESP[s]).
Maximum hammer energy (in kJ) is shown for driving of monopiles; maximum hammer energy for pin piles is 3500 kJ in all cases.

6.3.2 Marine Mammal Densities Used to Estimate Exposures Incidental to Foundation Installation

Monthly marine mammal densities are an estimate of the number of animals that could be present on any day of a given month in the area of sound exposure. As described in Section 6.1.1 above, these are used during exposure modeling to translate the number of simulated animats exposed above sound thresholds into an estimate of potential real-world marine mammal exposures per day in a given month. In model post-processing, these daily marine mammal exposures, which are specific to the month when the sound exposure occurs, are then multiplied by the number of days of sound exposure in that month. The number of days of pile driving per month is based on the proposed foundation installation schedules as provided in Table 20 - Table 33. As noted in Section 6.1.1, the densities used for each Vineyard Northeast activity are based on predicted areas of impact for each activity. For pile driving during foundation installation, the exposure model calculates densities based on pre-selected ranges of 1, 5, 10, 15, 20, 30, 40, and 50 km and then selects the appropriate density based on the 95th percentile exposure range ($ER_{95\%}$) for each species, modeled case (which includes foundation type and number installed per day as well as hammer type), and sound exposure threshold using the next highest range. For example, if the $ER_{95\%}$ for a given case is 8.5 km, then the pre-calculated density based on a 10-km range from the Lease Area is used. Figure 5 shows an example of how the Roberts et al. (2016; 2023; 2024) density grid cells are selected for a 10-km perimeter around the Lease Area and Table 34 shows the resulting density estimates. Densities for other perimeter sizes are provided in Appendix H of Appendix A.

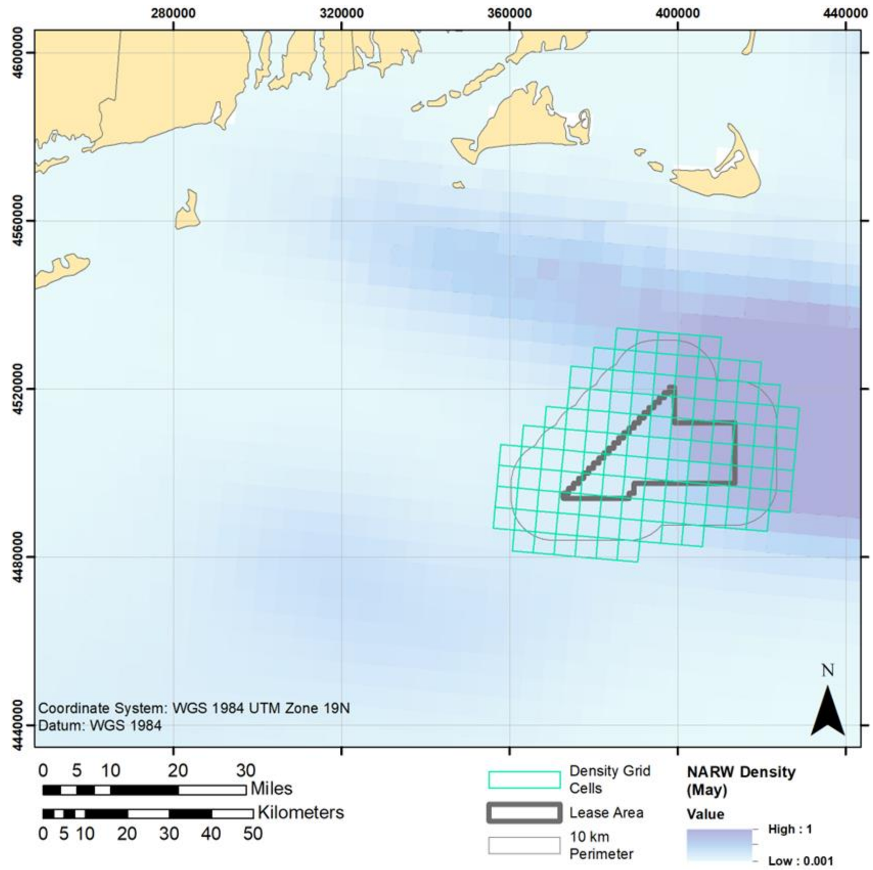

Figure 5. North Atlantic right whale (NARW) density map demonstrating how the Roberts et al. (2016; 2023; 2024) density grid cells are selected for an example 10 km perimeter around the Vineyard Northeast Lease Area (Reproduced from Figure 8 of Appendix A).

Table 34. Monthly marine mammal density estimates (animals/100 km^2) within a 10-km (6.2 mi) perimeter around the Lease Area, calculated from Duke/MGEL habitat-based density models (Roberts et al. 2016; 2023; 2024). Adapted from Table 31 of Appendix A.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mysticetes (LF hearing group)												
Fin whale*	0.231	0.176	0.163	0.158	0.325	0.364	0.503	0.399	0.274	0.096	0.063	0.154
Humpback whale	0.028	0.029	0.056	0.200	0.343	0.372	0.264	0.152	0.185	0.272	0.214	0.031
Minke whale	0.111	0.135	0.148	0.749	1.507	1.933	1.011	0.537	0.575	0.532	0.054	0.076
North Atlantic right whale*	1.079	1.200	1.032	0.891	0.712	0.177	0.123	0.056	0.091	0.109	0.234	0.717
Sei whale*	0.034	0.026	0.055	0.119	0.197	0.068	0.018	0.013	0.020	0.043	0.094	0.063
Odontocetes (MF hearing group)												
Sperm whale*	0.051	0.018	0.017	0.004	0.017	0.030	0.058	0.191	0.115	0.092	0.052	0.034
Atlantic spotted dolphin	<0.001	<0.001	0.002	0.008	0.034	0.066	0.056	0.088	0.444	0.598	0.131	0.011
Atlantic white-sided dolphin	2.704	1.525	1.118	1.789	3.979	4.178	2.769	1.127	2.221	3.346	2.489	3.679
Common bottlenose dolphin	0.460	0.114	0.084	0.241	1.008	1.696	2.070	2.262	2.230	1.984	1.685	1.323
Common dolphin	10.018	3.984	3.742	5.346	8.265	17.853	19.693	24.671	39.957	36.945	19.266	15.758
Pilot whale, long-finned	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276
Pilot whale, short-finned	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069
Risso's dolphin	0.048	0.007	0.005	0.025	0.150	0.112	0.138	0.320	0.384	0.184	0.147	0.195
Odontocetes (HF hearing group)												
Harbor porpoise	10.861	11.551	11.019	10.218	8.119	1.913	1.986	1.715	1.924	2.403	2.530	7.848
Pinnipeds (PPW hearing group)												
Gray seal	15.639	14.962	10.596	10.562	13.571	1.419	0.450	0.368	0.629	1.590	7.754	13.851
Harbor seal	3.152	3.016	2.136	2.129	2.735	0.286	0.091	0.074	0.127	0.320	1.563	2.792

* Indicates species listed as endangered under the US Endangered Species Act.

To estimate impacts from drilling during foundation installation, the maximum density month during May–November for each species was calculated from the Roberts et al. (2016; 2023; 2024) density models. The maximum density month was selected, as a conservative measure, assuming drilling could occur during any of these months[10]. Densities were calculated within a 5 km perimeter of the Lease Area for Level A exposures and within a 50 km perimeter of the Lease Area for Level B exposures (Table 35). As described in detail in Appendix I of Appendix A, these perimeter distances are based on the longest range to the Level A and Level B acoustic thresholds between the two modeled sites. The longest range for Level A exposures was 0.16 km and the longest range for Level B exposures was 49.78 km. These were rounded up to the nearest 5 km, that is, the size of the Roberts et al. (2016; 2023; 2024) density grid cells.

Table 35. Maximum monthly marine mammal density estimates (animals/100 km^2) during May–November within 5-km (Level A) and 50 km (Level B) perimeters around the Lease Area, calculated from Duke/MGEL habitat-based density models (Roberts et al. 2016; 2023; 2024), used to estimate drilling exposures. Adapted from Table I-6 of Appendix I of Appendix A.

Species	Maximum Density May–November	
	Level A	**Level B**
Mysticetes (LF hearing group)		
Fin whale*	0.502	0.529
Humpback whale	0.381	0.441
Minke whale	1.998	1.481
North Atlantic right whale*	0.673	0.538
Sei whale*	0.194	0.240
Odontocetes (MF hearing group)		
Sperm whale*	0.193	0.177
Atlantic spotted dolphin	0.516	1.485
Atlantic white-sided dolphin	4.082	5.378
Common bottlenose dolphin	2.249	3.281
Common dolphin	39.483	44.335
Pilot whale, long-finned	0.269	0.413
Pilot whale, short-finned	0.067	0.103
Risso's dolphin	0.337	1.850
Odontocetes (HF hearing group)		
Harbor porpoise	8.423	6.779
Pinnipeds (PPW hearing group)		
Gray seal	13.124	15.949
Harbor seal	2.645	3.215

* Indicates species listed as endangered under the US Endangered Species Act.

[10] As described in Section **Error! Reference source not found.**, foundation installation, including drilling, will not occur in May. As a result, the drilling exposure estimates are conservative for species whose highest densities occur in May.

6.3.3 Area Potentially Exposed to Sounds Above Threshold Levels from Pile Driving During Foundation Installation

The basic approach used in the acoustic modeling study (Appendix A) is to characterize the sounds produced by the source and determine how the sounds propagate within the surrounding water column to predict sound fields. For impact and vibratory pile driving sounds, time-domain representations of the pressure waves generated in the water are required for calculating sound pressure level (SPL) and peak pressure level (PK), which are then used to evaluate potential impacts. The source signatures associated with installing each of the modeled monopiles and jacket piles were predicted using a finite-difference model of the physical vibration of the pile caused by pile driving equipment. The pile as a sound source radiating into the environment was simulated as an array of point sources. For this study, synthetic pressure waveforms were computed using a Full Waveform Range-dependent Acoustic Model (FWRAM), which is JASCO's acoustic propagation model capable of producing time-domain waveforms. The sound propagation modeling incorporates site-specific environmental data including bathymetry, sound speed in the water column, and seabed geoacoustics in the proposed construction area.

Vineyard Northeast is located in a shallow, gently sloping, continental shelf environment characterized by predominantly fine-to-coarse grained sandy-seabed sediments, with some clay content. Water depths in the Vineyard Northeast Lease Area vary between approximately 32–64 m, while the surrounding areas of potential impact to marine fauna includes depths between 10–100 m. Solar heating of ocean surface layers, from June to November, can produce a downward refracting ocean environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy during winter, from December through May, results in a cooler surface layer. The cooler surface layer combined with a layer of warmer subsurface water may create sound ducts that enable sound to travel farther during these months.

Sound fields from the 14 m monopiles and 4.25 m pin piles were modeled at two representative locations in the Lease Area (Figure 6). The acoustic modeling locations were selected as they represent the range of water depths and bathymetric slopes in the Lease Area (i.e., 32–64 m [105–210 ft]).[11] Location L02 represents the deepest foundation position in the Lease Area at 63.2 m (207 ft) and is closer to the edge of the shelf break, and Location L01 represents the shallowest foundation position (40.1 m [132 ft]) that is farther from the shelf break and is not located on the shoal to the northeast of the Lease Area, as this shallow bathymetric feature is not representative of depths where the vast majority of foundations will be installed. Animal movement modeling assumed installation of piles at 14 different locations throughout the Lease Area (blue dots in Figure 6). These locations are spread evenly throughout the Lease Area to provide average exposure estimates. The closest acoustic modeling location is used for each animat modeling site. For cases where two foundations are installed per day, all 14 locations are modeled, two each day during the seven-day simulation. For cases where one foundation is installed per day, seven of these locations are selected, spread out evenly throughout the Lease Area, and one is modeled per day during the seven-day simulation. The seven-day average number of animats exposed during the simulation is then used as representative of an average foundation being installed. Seven-day simulations are run for each foundation type, number installed per day, season, attenuation level, and species.

[11] The range of water depths in the Lease Area of 32–64 m (105-210 ft) includes areas beyond the 1 NM x 1 NM grid of foundation positions.

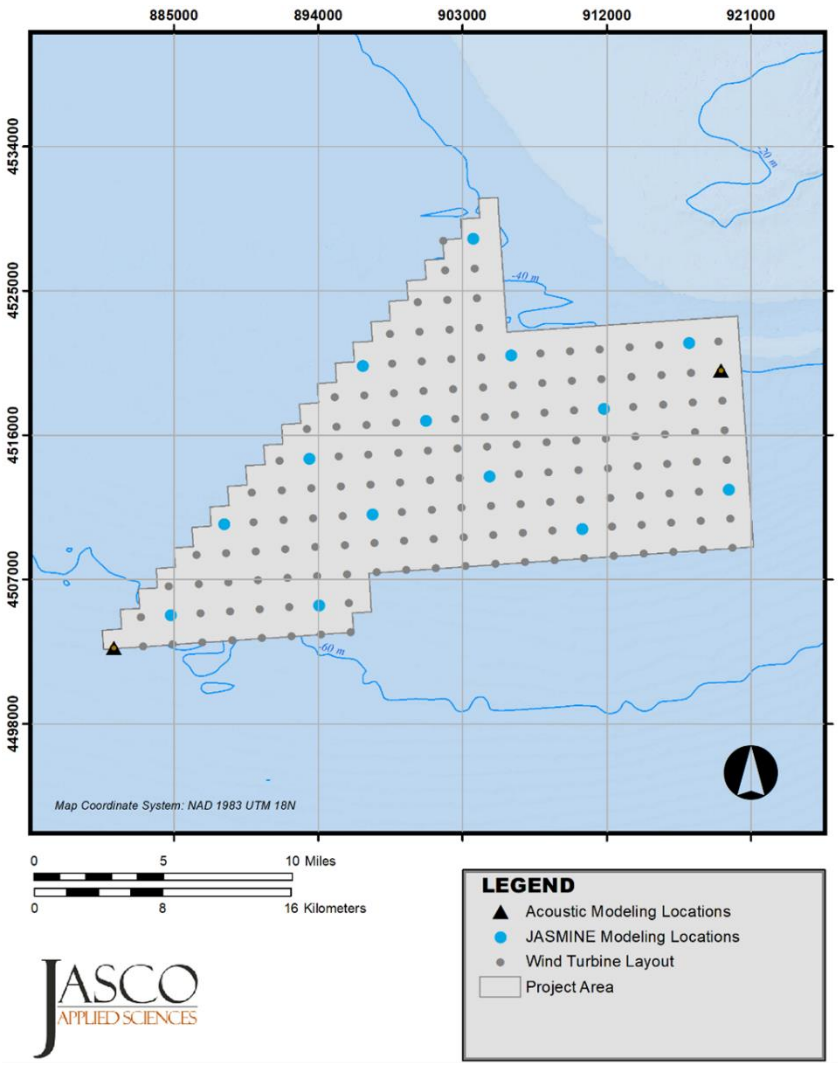

Figure 6. Locations within Lease Area OCS-A 0522 used for acoustic (black triangles) and animal movement (blue circles) modeling (Reproduced from Figure 2 of Appendix A) of foundation installation using impact and vibratory piling. L02 is the deeper modeling location in the southwest corner of the Lease Area. L01 is the shallower modeling location at the eastern edge of the Lease Area.

6.3.3.1 Summary of Methods Used for Acoustic Modeling of Impact Piling

Piles deform when driven with impulsive impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (e.g., marine mammals) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates, and the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness), and the type and energy of the hammer.

In the acoustic modeling study (Appendix A), a physical model of pile vibration and near-field sound radiation (MacGillivray 2014) was used in conjunction with the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010) to predict source levels associated with impact pile driving activities. Piles are modeled as a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation (pile type, material, size, and length), the pile driving equipment, and approximate pile penetration depth.

Forcing functions were computed for the monopiles and jacket foundation piles using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010). The model assumed direct contact between the representative hammers, helmets, and piles (i.e., no cushion material). The forcing functions serve as the inputs to JASCO's Pile Driving Source Model (PDSM), which was used to estimate equivalent acoustic source characteristics. JASCO's FWRAM propagation model was used to combine the outputs of the source model with spatial and temporal environmental factors (e.g., location, oceanographic conditions, and seabed type) to get time-domain representations of the sound signals in the environment and estimate sound field levels. This model is used to estimate the energy distribution per frequency (source spectrum) at a close distance from the source (10 m).

WTG jacket foundations are expected to be pre-piled, and ESP/booster station jacket foundations are expected to be post-piled. Pre-piling means that the jacket structure will be set on pre-installed piles. Post-piling means that the jacket structure is placed on the seafloor and piles are subsequently driven through guides at the base of each leg. These jacket foundations will also radiate sound as the piles are driven. To account for the larger radiating area in post-piled jackets for this study, the broadband sound level was increased by 2 dB for post-piling scenarios.

6.3.3.2 Summary of Methods Used for Acoustic Modeling of Vibratory Piling

During vibratory pile driving, a vibratory hammer creates a rapid set of deformations that propagate down the pile and cause the surrounding soil to liquefy, thereby reducing skin friction that supports the pile and placing more pressure on the bottom end of the pile (referred to as the toe). The vibrations also lead to small penetrations of the toe, so that the entire pile sinks into the seabed.

One-and-a-half second long vibratory forcing functions were computed for the 14 m monopile using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010). The vibratory forcing functions were then trimmed to one second duration plus a 50 millisecond tapered section at the start and end to avoid numerical edge effects. Clamps are used to connect the vibratory hammer to the pile. The model assumed the use of 20 clamps with a total weight of 1314 kN for the 14 m monopile. No cushion between the hammer and pile was used. Non-linearities were introduced to the vibratory forcing functions based on the decay rate observed in data measured during vibratory pile driving of smaller diameter piles (Quijano et al. 2017). The clipped and tapered forcing functions were used as inputs to JASCO's PDSM, which was used to estimate an equivalent acoustic source represented by a linear array of monopoles evenly distributed along the pile. Sound propagation of the vibratory pile driving source signature was performed using FWRAM.

6.3.3.3 Noise Abatement Systems

Noise abatement systems (NAS) are often used to decrease the sound levels in the water near a source by inserting a local impedance change and absorbing layer into the water column that acts as a barrier to sound transmission. Various technologies can achieve attenuation by changing impedance. These technologies include big bubble curtains, evacuated sleeve systems (e.g., IHC-Noise Mitigation System [NMS]), encapsulated bubble systems (e.g., HydroSound Dampers), or Helmholtz resonators

(AdBm NMS). The effectiveness of each system is frequency-dependent and may be influenced by local environmental conditions such as water current and depth. For example, the size of the bubbles determines the effective frequency band of absorption. Effective air bubble curtains use a range of bubble diameters to optimize their performance over a wide range of sound frequencies.

The type of NAS to be used during construction have not yet been determined. However, NAS performance of 10 dB broadband attenuation was assumed when calculating ranges to threshold levels and potential exposures used in developing the total requested take incidental to impact pile driving and vibratory pile setting. A 10 dB decrease means the sound energy level is reduced by 90 percent. The use of NAS during foundation installation is further described in Section **Error! Reference source not found.**.

6.3.3.4 *Drilling During Foundation Installation*

Drilling during foundation installation is not a planned activity and would only be used if pile refusal were encountered during impact pile driving. Thus, drilling could be used during any month when foundation installation is occurring (see Section **Error! Reference source not found.**), and drilling sound exposures are considered as part of foundation installation. An impact analysis for drilling that involved modeling acoustic ranges and using these to calculate density-based exposure estimates for the ensonified area was conducted and is provided as Appendix I of Appendix A. The acoustic modeling used published information on drilling source levels estimated by Austin et al. (2018) that were fed into JASCO's Marine Operations Noise Model (MONM) to model the sound propagation at the two modeled locations and predict ranges to SEL_{cum} and SPL_{rms} sound exposure thresholds. These ranges were then converted to areas using the formula $Area = \pi r^2$, and this area (in km^2) was multiplied by the number of animals/km^2 from the Roberts et al. (2016; 2023; 2024) density models. The drilling analysis used the maximum density month for summer months (May–November) for each species, as a conservative measure.

Drilling is most likely to be used for monopiles in the southwestern portion of the Lease Area where it was assumed that monopiles would be installed using vibratory pile setting followed by impact pile driving. Because all monopiles anticipated to require drilling were assumed to require vibratory pile setting, the estimated ranges to behavioral harassment thresholds from drilling are less than from vibratory pile setting, and exposure to sound above a behavioral response threshold is a one-time exposure per day, it is assumed that potential Level B exposures from drilling activity would be duplicative of estimates of take from vibratory pile setting. Therefore, the estimated Level B exposures from drilling were not incorporated into the estimated take to avoid double counting.

Maximum predicted injury exposures were <0.01 for modeled marine mammals; marine mammal PTS is unlikely to occur because the ranges to injurious thresholds are <160 m for all species (See Appendix I of Appendix A). Therefore, no Level A from drilling is requested (Section 6.3.4).

6.3.3.5 *Modeled Acoustic Ranges*

Table 36 and Table 37 show the modeled acoustic ranges to the PTS onset (Level A) thresholds for the different foundation types used in Schedule A and Schedule B, respectively. The ranges shown are the longest of the two model sites (L01 and L02) and use the summer sound speed profile, for pile driving during June–November. Ranges using the winter sound speed profile are available in Appendix A for reference. The Level A ranges shown for combined impact and vibratory pile driving use the thresholds for impact piling (an impulsive sound), which are lower than those used for vibratory pile setting (a non-impulsive sound), to provide a conservative estimate of the number of animals exposed above sound thresholds. SEL_{cum} ranges are based on the sounds accumulated for the two sound sources (vibratory pile setting and impact pile driving). For the high-frequency cetacean hearing group, both the SEL_{cum} and SPL_{pk} ranges are shown because SPL_{pk} ranges for monopiles were longer for this hearing group.

Table 36. Modeled acoustic ranges ($R_{95\%}$) in kilometers (km) to PTS onset (Level A) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule A, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

		Acoustic Range (km)							
							WTG Jacket		ESP Jacket
		14 m Monopile 6600 kJ		14 m DTD Monopile 6600 kJ		14 m Monopile 8000 kJ	Pre-piled 4.25 m pin pile 3 per day	Pre-piled 4.25 m pin pile 4 per day	Post-piled 4.25 m pin pile 4 per day
Hearing Group	Level A Threshold[a]	Impact Only	Impact & Vibratory	Impact Only	Impact & Vibratory	Impact Only	Impact Only	Impact Only	Impact Only
Low-frequency cetacean	183	6.00	3.93	6.97	5.12	7.41	7.62	8.51	10.10
Mid-frequency cetacean	185	-	-	-	-	-	-	-	-
High frequency cetacean (SELcum)[a]	155	0.09	-	0.13	0.04	0.14	0.69	0.74	0.95
High frequency cetacean (SPLpk)[a]	202	0.19	0.19	0.19	0.19	0.20	0.11	0.11	0.13
Phocid pinniped in water	185	0.73	0.33	1.12	0.57	1.24	1.02	1.22	1.57

WTG = wind turbine generator, ESP = electrical service platform, which includes the booster station.
[a] For high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range for monopile foundations. Both ranges are shown here for comparison.

Table 37. Modeled acoustic ranges ($R_{95\%}$) in kilometers (km) to PTS onset (Level A) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule B, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

		Acoustic Range (km)			
				WTG Jacket	ESP Jacket
		14 m Monopile 8000 kJ		Pre-piled 4.25 m pin pile 4 per day	Post-piled 4.25 m pin pile 4 per day
Hearing Group	Level A Threshold[a]	Impact Only	Impact & Vibratory	Impact Only	Impact Only
Low-frequency cetacean	183	7.41	5.25	8.51	10.10
Mid-frequency cetacean	185	-	-	-	-
High frequency cetacean (SELcum)[a]	155	0.14	0.05	0.74	0.95
High frequency cetacean (SPLpk)[a]	202	0.20	0.20	0.11	0.13
Phocid pinniped in water	185	1.24	0.59	1.22	1.57

WTG = wind turbine generator, ESP = electrical service platform, which includes the booster station.
[a] For high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range for monopile foundations. Both ranges are shown here for comparison.

Table 38 and Table 39 show the modeled acoustic ranges to the behavioral (Level B) thresholds for the different foundation types used in Schedule A and Schedule B, respectively. The ranges shown are the longest of the two model sites (L01 and L02) and use the summer sound speed profile for pile driving.

Table 38. Modeled acoustic ranges ($R_{95\%}$) to behavioral (Level B) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule A, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

Hearing Group	Level B Threshold[a]	Acoustic Range (km)							
		14 m Monopile 6600 kJ		14 m DTD Monopile 6600 kJ		14 m Monopile 8000 kJ	WTG Jacket Pre-piled 4.25 m pin pile 3 per day	WTG Jacket Pre-piled 4.25 m pin pile 4 per day	ESP Jacket Post-piled 4.25 m pin pile 4 per day
		Impact	Vibratory	Impact	Vibratory	Impact	Impact	Impact	Impact
All hearing groups	160/120	6.76	30.29	7.09	31.60	7.63	4.36	4.36	5.35

WTG = wind turbine generator, DTD = difficult to drive, ESP = electrical service platform, which includes the booster station.
[a] Vibratory ranges for the 14 m DTD monopile (6600 kJ) and the 14 m monopile (8000 kJ) are the same because both used 60 minutes of vibratory pile setting with the same hammer.

Table 39. Modeled acoustic ranges ($R_{95\%}$) to behavioral (Level B) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule B, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

Hearing Group	Level B Threshold[a]	Acoustic Range (km)			
		14 m Monopile 8000 kJ		WTG Jacket Pre-piled 4.25 m pin pile 4 per day	ESP Jacket Post-piled 4.25 m pin pile 4 per day
		Impact	Vibratory	Impact	Impact
All hearing groups	160/120	7.63	31.60	4.36	5.35

WTG = wind turbine generator, ESP = electrical service platform, which includes the booster station.

Modeled acoustic ranges ($R_{95\%}$) to the Level A and Level B thresholds used to assess impacts of potential drilling during foundation installation are shown in Table 40. Ranges are shown for the two model locations, using the summer sound speed profile, and assuming 6 hours of drilling per 24 hours. Only the summer ranges are shown because foundation installation is not scheduled for winter (December). Winter ranges are available for comparison in Appendix I of Appendix A.

Table 40. Modeled acoustic ranges ($R_{95\%}$) in meters (m) and predicted areas in square kilometers (km^2) ensonified to PTS onset (Level A) and behavioral (Level B) sound exposure thresholds for the different marine mammal hearing groups for potential drilling during foundation installation for the two model sites using the summer sound speed profile.

Hearing Group	Level A Threshold[a]	Range to Threshold (m)		Ensonified Area (km^2)	
		L01	L02	L01	L02
Low-frequency cetacean	199	130	100	0.056	0.034
Mid-frequency cetacean	198	<20	<20	<0.020	<0.020
High-frequency cetacean	173	153	117	0.078	0.044
Phocid pinniped in water	201	30	22	<0.020	<0.020
Hearing Group	**Level B Threshold**	**Range to Threshold (m)**		**Ensonified Area (km^2)**	
		L01	**L02**	**L01**	**L02**
All hearing groups	120	15,772	23,380	712.714	1,611.280

6.3.3.6 Modeled Exposure Ranges

By incorporating animal movement into the calculation of ranges to time-dependent thresholds (SEL metrics), exposure ranges ($ER_{95\%}$) provide a more realistic assessment of the distances within which acoustic thresholds may be exceeded. This also means that different species within the same hearing group can have different exposure ranges as a result of differences in behavior for each species. Level A (PTS onset) and Level B exposure ranges for the foundation types used in Schedule A are provided in Table 41 and Table 42, respectively, and exposure ranges for the foundation types used in Schedule B are provided in Table 43 and

Table 44, respectively. Level A ranges are shown for each of the different low frequency hearing cetaceans. These ranges show variation among species by distances greater than one kilometer for some foundation types. All mid-frequency cetaceans had Level A exposure ranges of zero; therefore, these ranges are not shown individually for each species. For high-frequency cetaceans, the SPL_{pk} range was greater than the SEL_{cum} range in all cases, so the ranges shown in Table 41 and Table 43 for this species are based on SPL_{pk}. Level B exposure ranges are also shown for each of the low frequency cetacean species. For mid-frequency cetaceans, the exposure ranges for sperm whales (an endangered species) are provided separately, and the ranges for the remainder of the mid-frequency cetaceans (all delphinids) are the maximum of those seven species. For phocid pinnipeds, both the Level A and Level B exposure ranges are the maximum for the two species.

In Tables 41–44, differences in $ER_{95\%}$ between one- and two-pile per day scenarios are driven by multiple non-exclusive factors. Some of the differences could be attributed to stochasticity in the underlying model, animal density in the affected area, and (to a minor extent) numerical gridding in the model may affect short ranges. In the case of the SEL_{cum} metric, the $ER_{95\%}$ values for two piles per day are consistently larger than for one pile per day, which highlights the effect of the higher energy accumulated by adding the second pile. For SPL_{pk} and SPL_{rms} (for which energy accumulation is not a factor), these differences are likely due to stochasticity in the model.

Table 41. Exposure ranges ($ER_{95\%}$) to Level A sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule A, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

Hearing Group	Level A Threshold[a]	Exposure Range (km) 14 m Monopile 6600 kJ 1 pile per day Impact Only	14 m Monopile 6600 kJ 1 pile per day Impact & Vibratory	14 m Monopile 6600 kJ 2 piles per day Impact Only	14 m Monopile 6600 kJ 2 piles per day Impact & Vibratory	14 m DTD Monopile 6600 kJ 1 pile per day Impact Only	14 m DTD Monopile 6600 kJ 1 pile per day Impact & Vibratory	14 m Monopile 8000 kJ 1 pile per day Impact Only	WTG Jacket Pre-piled 4.25 m pin pile 3 piles per day Impact Only	WTG Jacket Pre-piled 4.25 m pin pile 4 piles per day Impact Only	ESP Jacket Post-piled 4.25 m pin pile 4 piles per day Impact Only
Low-frequency cetacean	183										
Fin whale*		3.43	3.41	3.94	3.90	4.21	4.09	4.46	3.37	3.84	4.97
Humpback whale		3.39	3.32	3.54	3.51	4.09	3.85	4.24	2.82	3.11	3.89
Minke whale		2.35	2.29	3.01	2.91	3.15	2.85	3.25	1.56	1.85	2.36
North Atlantic right whale*		3.22	3.17	3.27	3.21	3.74	3.72	4.10	2.20	2.43	3.25
Sei whale*		3.09	3.10	3.14	3.13	3.17	3.18	3.51	1.82	2.15	2.65
Mid-frequency cetacean	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High frequency cetacean	202[a]	0.10	0.10	0.09	0.09	0.10	0.10	0.10	0.02	0.02	0.07
Phocid pinniped in water[b]	185	0.39	0.39	0.38	0.29	0.65	0.65	0.68	0.66	0.66	0.98

* Indicates species listed as endangered under the US Endangered Species Act.

[a] For high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range, so SPL_{pk} is shown as the Level A range for this hearing group.

[b] For phocid pinnipeds, the largest exposure range for the two species is shown.

Table 42. Exposure ranges ($ER_{95\%}$) to Level B sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule A, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

		Exposure Range (km)									
									WTG Jacket		ESP Jacket
	Level B	14 m Monopile 6600 kJ 1 pile per day		14 m Monopile 6600 kJ 2 piles per day		14 m DTD Monopile 6600 kJ 1 pile per day		14 m Monopile 8000 kJ 1 pile per day	Pre-piled 4.25 m pin pile 3 piles per day	Pre-piled 4.25 m pin pile 4 piles per day	Post-piled 4.25 m pin pile 4 piles per day
Hearing Group	**Threshold[a]**	**Impact**	**Vibratory**	**Impact**	**Vibratory**	**Impact**	**Vibratory**	**Impact**	**Impact**	**Impact**	**Impact**
Low-frequency cetacean	160/120										
Fin whale*		6.48	29.04	6.35	29.59	6.60	30.66	6.94	3.55	3.53	4.22
Humpback whale		5.99	28.51	6.22	29.21	6.21	30.03	6.90	3.41	3.44	4.23
Minke whale		5.74	26.00	5.96	26.62	6.02	27.60	6.47	3.20	3.24	3.76
North Atlantic right whale*		5.89	27.24	5.97	27.08	6.30	28.33	6.67	3.24	3.22	3.93
Sei whale*		6.42	29.07	6.38	29.76	6.53	31.32	7.00	3.35	3.45	4.20
Mid-frequency cetacean	160/120										
Sperm whale*		5.84	28.43	6.02	29.13	6.33	30.13	6.74	3.37	3.35	4.09
Delphinids[b]		6.22	28.01	6.48	29.71	6.62	29.25	6.96	3.68	3.67	4.43
High frequency cetacean	160/120	5.43	20.12	5.46	20.26	5.61	20.72	6.03	2.80	2.92	3.49
Phocid pinniped in water[c]	160/120	6.54	29.08	6.48	29.68	6.83	30.83	7.54	3.95	4.00	4.98

* Indicates species listed as endangered under the US Endangered Species Act.

[a] The Level B sound exposure thresholds for all hearing groups are 160 dB SPL_{rms} for impact pile driving and 120 dB SPL_{rms} for vibratory pile setting. Impact ranges are from cases with only impact pile driving. Vibratory ranges are from cases with vibratory pile setting followed by impact piling - ranges are from the time when vibratory pile setting was occurring.

[b] For delphinids, the largest exposure range for the seven species is shown.

[c] For phocid pinnipeds, the largest exposure range for the two species is shown.

Table 43. Exposure ranges ($ER_{95\%}$) to Level A sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule B, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

		Exposure Range (km)				
					WTG Jacket	ESP Jacket
		14 m Monopile 8000 kJ 1 pile per day		14 m Monopile 8000 kJ 2 piles per day	Pre-piled 4.25 m pin pile 4 piles per day	Post-piled 4.25 m pin pile 4 piles per day
Hearing Group	**Level A Threshold[a]**	**Impact Only**	**Impact & Vibratory**	**Impact Only**	**Impact Only**	**Impact Only**
Low-frequency cetacean	183					
Fin whale*		4.46	4.45	5.01	3.84	4.97
Humpback whale		4.24	4.20	4.41	3.11	3.89
Minke whale		3.25	3.19	3.56	1.85	2.36
North Atlantic right whale*		4.10	4.05	4.28	2.43	3.25
Sei whale*		3.51	3.58	3.89	2.15	2.65
Mid-frequency cetacean	185	0.00	0.00	0.00	0.00	0.00
High frequency cetacean	202[a]	0.10	0.10	0.11	0.02	0.07
Phocid pinniped in water[b]	185	0.68	0.68	0.70	0.66	0.98

* Indicates species listed as endangered under the US Endangered Species Act.

[a] For high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range, so SPL_{pk} is shown as the Level A range for this hearing group.

[b] For phocid pinnipeds, the largest exposure range for the two species is shown.

Table 44. Exposure ranges ($ER_{95\%}$) to Level B sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule B, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

Hearing Group	Level B Threshold[a]	14 m Monopile 8000 kJ 1 pile per day Impact	14 m Monopile 8000 kJ 1 pile per day Vibratory	14 m Monopile 8000 kJ 2 piles per day Impact	WTG Jacket Pre-piled 4.25 m pin pile 4 piles per day Impact	ESP Jacket Post-piled 4.25 m pin pile 4 piles per day Impact
Low-frequency cetacean	160/120					
Fin whale*		6.94	30.66	7.03	3.53	4.22
Humpback whale		6.90	30.03	6.86	3.44	4.23
Minke whale		6.47	27.60	6.61	3.24	3.76
North Atlantic right whale*		6.67	28.33	6.70	3.22	3.93
Sei whale*		7.00	31.32	7.15	3.45	4.20
Mid-frequency cetacean	160/120					
Sperm whale*		6.74	30.13	6.83	3.35	4.09
Delphinids[b]		6.96	29.25	7.22	3.67	4.43
High frequency cetacean	160/120	6.03	20.72	6.16	2.92	3.49
Phocid pinniped in water[c]	160/120	7.54	30.83	7.12	4.00	4.98

* Indicates species listed as endangered under the US Endangered Species Act.
[a] The Level B sound exposure thresholds for all hearing groups are 160 dB SPL_{rms} for impact pile driving and 120 dB SPL_{rms} for vibratory pile setting. Impact ranges are from cases with only impact pile driving. Vibratory ranges are from cases with vibratory pile setting followed by impact piling - ranges are from the time when vibratory pile setting was occurring.
[b] For delphinids, the largest exposure range for the seven species is shown.
[c] For phocid pinnipeds, the largest exposure range for the two species is shown.

6.3.4 Exposure and Take Estimates Incidental to Foundation Installation

Exposure modeling was conducted for the full buildout of Vineyard Northeast as well as for Project 1 and Project 2 separately, using the assumptions and installation schedules provided in Section 6.3.1. The estimated numbers of marine mammals exposed to sounds above threshold levels as well as the estimated takes for each of these are provided in the subsections below. As noted above, Level B exposures from the exposure modeling were compared with PSO daily sighting rates and with mean group size for each species. The highest of these three estimates is used in the estimated take.

6.3.4.1 Vineyard Northeast Full Buildout

The exposure estimates and estimated take from full buildout of Vineyard Northeast assuming two years of construction described in Schedule A are shown in Table 45 and Table 46. If construction occurs over four years as described in Schedule B, then the estimated exposures and takes for each of those four years are shown in Table 47 through Table 50. These estimates account for the actual number of available foundations and thereby avoid overestimation of exposure and potential take associated with summing the results from Project 1 and Project 2, which both include some overlapping foundation positions.

Table 45. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule A, year 3 (2030), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule A – Year 3 (2030)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	22.15	0.02	50.45	28.64	2.0	23	51
Humpback whale	16.20	0.00	35.09	51.35	2.2	17	52
Minke whale	60.36	0.20	164.88	23.09	1.4	61	165
North Atlantic right whale*	4.67	0.01	13.35	2.97	2.0	5	14
Sei whale*	1.05	0.00	3.37	5.55	1.7	2	6
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	20.16	-	2.0	0	21
Atlantic spotted dolphin	0.00	0.00	17.05	1.11	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	587.25	3.00	19.1	0	588
Common bottlenose dolphin	0.00	0.00	588.30	216.23	13.0	0	589
Common dolphin	0.00	0.00	10747.06	1813.00	24.3	0	10748
Pilot whale, long-finned	0.00	0.00	61.89	24.72	6.2	0	62
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	77.62	1.33	12.0	0	78
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.87	269.92	-	2.5	3	270
Pinnipeds (PPW hearing group)							
Gray seal	0.61	0.00	58.50	14.67	1.4	1	59
Harbor seal	0.03	0.01	11.41	2.96	1.4	1	12

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback and sei whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 46. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule A, year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate PTS SEL_{cum}	Modeled Exposure Estimate PTS SPL_{pk}	Modeled Exposure Estimate Behavior	PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule A – Year 4 (2031) Level A Take	Total Estimated Take Full Buildout Schedule A – Year 4 (2031) Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	24.25	0.04	234.28	26.62	2.0	25	235
Humpback whale	17.96	0.00	138.39	47.72	2.2	18	139
Minke whale	69.58	0.12	454.74	21.46	1.4	70	455
North Atlantic right whale*	4.99	0.01	54.06	2.76	2.0	5	55
Sei whale*	1.16	0.01	12.95	5.16	1.7	2	13
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	67.30	-	2.0	0	68
Atlantic spotted dolphin	0.00	0.00	171.90	1.03	24.0	0	172
Atlantic white-sided dolphin	0.00	0.00	1793.83	2.79	19.1	0	1794
Common bottlenose dolphin	0.00	0.00	1616.59	200.96	13.0	0	1617
Common dolphin	0.00	0.00	32125.13	1685.03	24.3	0	32126
Pilot whale, long-finned	0.00	0.00	216.84	22.97	6.2	0	217
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	449.67	1.24	12.0	0	450
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	3.19	882.37	-	2.5	4	883
Pinnipeds (PPW hearing group)							
Gray seal	0.65	0.00	1040.50	13.63	1.4	1	1041
Harbor seal	0.02	0.01	95.73	2.75	1.4	1	96

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 47. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 2 (2029), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule B – Year 2 (2029)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	14.45	0.01	29.77	14.15	2.0	15	30
Humpback whale	10.65	0.00	21.54	25.37	2.2	11	26
Minke whale	40.43	0.10	104.93	11.41	1.4	41	105
North Atlantic right whale*	3.08	0.01	8.45	1.47	2.0	4	9
Sei whale*	0.76	0.01	2.40	2.74	1.7	1	3
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	12.68	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	9.01	0.55	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	358.26	1.48	19.1	0	359
Common bottlenose dolphin	0.00	0.00	368.57	106.84	13.0	0	369
Common dolphin	0.00	0.00	6116.04	895.84	24.3	0	6117
Pilot whale, long-finned	0.00	0.00	38.25	12.21	6.2	0	39
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	45.02	0.66	12.0	0	46
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.36	161.22	-	2.5	3	162
Pinnipeds (PPW hearing group)							
Gray seal	0.54	0.00	43.45	7.25	1.4	1	44
Harbor seal	0.04	0.01	8.21	1.46	1.4	1	9

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 48. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 3 (2030), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Full Buildout Schedule B – Year 3 (2030)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	14.38	0.01	29.59	13.81	2.0	15	30
Humpback whale	10.37	0.00	20.93	24.77	2.2	11	25
Minke whale	39.90	0.10	103.34	11.14	1.4	40	104
North Atlantic right whale*	3.01	0.01	8.24	1.43	2.0	4	9
Sei whale*	0.73	0.01	2.31	2.68	1.7	1	3
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	12.47	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	8.36	0.54	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	346.33	1.45	19.1	0	347
Common bottlenose dolphin	0.00	0.00	361.69	104.30	13.0	0	362
Common dolphin	0.00	0.00	5940.69	874.51	24.3	0	5941
Pilot whale, long-finned	0.00	0.00	37.45	11.92	6.2	0	38
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	44.36	0.64	12.0	0	45
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.30	156.88	-	2.5	3	157
Pinnipeds (PPW hearing group)							
Gray seal	0.51	0.00	41.32	7.08	1.4	1	42
Harbor seal	0.04	0.01	7.82	1.43	1.4	1	8

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 49. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule B – Year 4 (2031)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	15.73	0.05	123.65	14.83	2.0	16	124
Humpback whale	14.40	0.00	99.67	26.58	2.2	15	100
Minke whale	59.74	0.13	381.41	11.95	1.4	60	382
North Atlantic right whale*	4.43	0.01	37.50	1.54	2.0	5	38
Sei whale*	1.22	0.00	12.70	2.87	1.7	2	13
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	23.56	-	2.0	0	24
Atlantic spotted dolphin	0.00	0.00	30.24	0.58	24.0	0	31
Atlantic white-sided dolphin	0.00	0.00	1290.12	1.55	19.1	0	1291
Common bottlenose dolphin	0.00	0.00	836.54	111.93	13.0	0	837
Common dolphin	0.00	0.00	13749.88	938.50	24.3	0	13750
Pilot whale, long-finned	0.00	0.00	105.59	12.80	6.2	0	106
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	126.82	0.69	12.0	0	127
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.27	475.42	-	2.5	3	476
Pinnipeds (PPW hearing group)							
Gray seal	0.82	0.00	1021.09	7.59	1.4	1	1022
Harbor seal	0.02	0.00	62.43	1.53	1.4	1	63

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 50. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 5 (2032), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule B – Year 5 (2032)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	18.97	0.09	19.99	14.83	2.0	19	20
Humpback whale	16.34	0.00	20.30	26.58	2.2	17	27
Minke whale	72.53	0.10	132.75	11.95	1.4	73	133
North Atlantic right whale*	4.99	0.00	7.69	1.54	2.0	5	8
Sei whale*	1.29	0.00	3.46	2.87	1.7	2	4
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	14.64	-	2.0	0	15
Atlantic spotted dolphin	0.00	0.00	9.26	0.58	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	491.23	1.55	19.1	0	492
Common bottlenose dolphin	0.00	0.00	555.55	111.93	13.0	0	556
Common dolphin	0.00	0.00	9407.19	938.50	24.3	0	9408
Pilot whale, long-finned	0.00	0.00	51.20	12.80	6.2	0	52
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	63.04	0.69	12.0	0	64
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.32	198.61	-	2.5	3	199
Pinnipeds (PPW hearing group)							
Gray seal	0.78	0.00	15.13	7.59	1.4	1	16
Harbor seal	0.01	0.00	6.75	1.53	1.4	1	7

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

6.3.4.2 Project 1

It is expected that the northeastern portion of the Lease Area (Project 1) will be built out first. The modeled exposures and estimated takes incidental to foundation installations for Project 1 are provided in Table 51 through Table 54. Under Schedule A, most Project 1 installation activity and associated take would occur during Year 3 (2030; Table 51) with a small number of installations occurring in Year 4 (2031; Table 52). Under Schedule B, installations and associated take would be spread more evenly across Year 2 (2029; Table 53) and Year 3 (2030; Table 54). These estimates include potential takes from installing foundations at the 10 positions that overlap with Project 2.

Table 51. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule A, year 3 (2030), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 1 Max Schedule A – Year 3 (2030)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	22.15	0.02	50.45	28.64	2.0	23	51
Humpback whale	16.20	0.00	35.09	51.35	2.2	17	52
Minke whale	60.36	0.20	164.88	23.09	1.4	61	165
North Atlantic right whale*	4.67	0.01	13.35	2.97	2.0	5	14
Sei whale*	1.05	0.00	3.37	5.55	1.7	2	6
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	20.16	-	2.0	0	21
Atlantic spotted dolphin	0.00	0.00	17.05	1.11	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	587.25	3.00	19.1	0	588
Common bottlenose dolphin	0.00	0.00	588.30	216.23	13.0	0	589
Common dolphin	0.00	0.00	10747.06	1813.00	24.3	0	10748
Pilot whale, long-finned	0.00	0.00	61.89	24.72	6.2	0	62
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	77.62	1.33	12.0	0	78
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.87	269.92	-	2.5	3	270
Pinnipeds (PPW hearing group)							
Gray seal	0.61	0.00	58.50	14.67	1.4	1	59
Harbor seal	0.03	0.01	11.41	2.96	1.4	1	12

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback and sei whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 52. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule A, year 4 (2031), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 1 Max Schedule A – Year 4 (2031)	
Species	**PTS SEL_{cum}**	**PTS SPL_{pk}**	**Behavior**	**Based Estimate[a]**	**Group Size[b]**	**Level A Take**	**Level B Take[c]**
Mysticetes (LF hearing group)							
Fin whale*	1.15	0.00	30.71	1.68	2.0	2	31
Humpback whale	0.87	0.00	18.04	3.02	2.2	1	19
Minke whale	3.60	0.02	60.48	1.36	1.4	4	61
North Atlantic right whale*	0.24	0.00	6.70	0.17	2.0	1	7
Sei whale*	0.05	0.00	1.53	0.33	1.7	1	2
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	3.22	-	2.0	0	4
Atlantic spotted dolphin	0.00	0.00	3.32	0.07	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	198.64	0.18	19.1	0	199
Common bottlenose dolphin	0.00	0.00	96.72	12.72	13.0	0	97
Common dolphin	0.00	0.00	1548.79	106.65	24.3	0	1549
Pilot whale, long-finned	0.00	0.00	17.21	1.45	6.2	0	18
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	20.39	0.08	12.0	0	21
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	0.08	86.33	-	2.5	1	87
Pinnipeds (PPW hearing group)							
Gray seal	0.02	0.00	102.64	0.86	1.4	1	103
Harbor seal	0.00	0.00	10.58	0.17	1.4	0	11

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 53. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule B year 2 (2029), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 1 Max Schedule B – Year 2 (2029)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	14.45	0.01	29.77	14.15	2.0	15	30
Humpback whale	10.65	0.00	21.54	25.37	2.2	11	26
Minke whale	40.43	0.10	104.93	11.41	1.4	41	105
North Atlantic right whale*	3.08	0.01	8.45	1.47	2.0	4	9
Sei whale*	0.76	0.01	2.40	2.74	1.7	1	3
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	12.68	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	9.01	0.55	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	358.26	1.48	19.1	0	359
Common bottlenose dolphin	0.00	0.00	368.57	106.84	13.0	0	369
Common dolphin	0.00	0.00	6116.04	895.84	24.3	0	6117
Pilot whale, long-finned	0.00	0.00	38.25	12.21	6.2	0	39
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	45.02	0.66	12.0	0	46
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.36	161.22	-	2.5	3	162
Pinnipeds (PPW hearing group)							
Gray seal	0.54	0.00	43.45	7.25	1.4	1	44
Harbor seal	0.04	0.01	8.21	1.46	1.4	1	9

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 54. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule B year 3 (2030), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 1 Max Schedule B – Year 3 (2030)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	15.78	0.01	55.16	15.50	2.0	16	56
Humpback whale	12.21	0.00	51.30	27.79	2.2	13	52
Minke whale	49.59	0.13	220.49	12.50	1.4	50	221
North Atlantic right whale*	3.59	0.02	19.33	1.61	2.0	4	20
Sei whale*	0.92	0.01	6.87	3.00	1.7	1	7
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	15.54	-	2.0	0	16
Atlantic spotted dolphin	0.00	0.00	17.48	0.60	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	698.98	1.63	19.1	0	699
Common bottlenose dolphin	0.00	0.00	491.98	117.02	13.0	0	492
Common dolphin	0.00	0.00	8061.40	981.16	24.3	0	8062
Pilot whale, long-finned	0.00	0.00	58.29	13.38	6.2	0	59
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	63.52	0.72	12.0	0	64
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.52	251.02	-	2.5	3	252
Pinnipeds (PPW hearing group)							
Gray seal	0.61	0.00	421.35	7.94	1.4	1	422
Harbor seal	0.05	0.01	29.72	1.60	1.4	1	30

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.
[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

6.3.4.3 Project 2

The modeled exposures and estimated takes incidental to foundation installations for Project 2 are provided in Table 55 through Table 58. Under Schedule A, most Project 2 installation activity and associated take would occur during Year 4 (2031; Table 56) with a lesser number of installations occurring in Year 3 (2030; Table 55). Under Schedule B, installations and associated take would be spread more evenly across Year 4 (2031; Table 57) and Year 5 (2032; Table 58). These estimates include potential takes from installing foundations at the 10 positions that overlap with Project 1.

Table 55. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule A year 3 (2030), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule A – Year 3 (2030)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	0.37	0.00	1.01	1.68	2.0	1	2
Humpback whale	0.86	0.00	2.18	3.02	2.2	1	4
Minke whale	1.63	0.01	5.18	1.36	1.4	2	6
North Atlantic right whale*	0.29	0.01	0.94	0.17	2.0	1	2
Sei whale*	0.10	0.00	0.36	0.33	1.7	1	2
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	0.80	-	2.0	0	2
Atlantic spotted dolphin	0.00	0.00	1.85	0.07	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	38.51	0.18	19.1	0	39
Common bottlenose dolphin	0.00	0.00	25.31	12.72	13.0	0	26
Common dolphin	0.00	0.00	605.49	106.65	24.3	0	606
Pilot whale, long-finned	0.00	0.00	3.06	1.45	6.2	0	7
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	3.08	0.08	12.0	0	12
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	0.14	16.64	-	2.5	1	17
Pinnipeds (PPW hearing group)							
Gray seal	0.12	0.00	13.72	0.86	1.4	1	14
Harbor seal	0.01	0.00	2.51	0.17	1.4	1	3

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.
[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for fin, North Atlantic right, sei, and sperm whales; Atlantic spotted and Risso's dolphins; and long- and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 56. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule A year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule A – Year 4 (2031)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	24.25	0.04	234.28	26.62	2.0	25	235
Humpback whale	17.96	0.00	138.39	47.72	2.2	18	139
Minke whale	69.58	0.12	454.74	21.46	1.4	70	455
North Atlantic right whale*	4.99	0.01	54.06	2.76	2.0	5	55
Sei whale*	1.16	0.01	12.95	5.16	1.7	2	13
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	67.30	-	2.0	0	68
Atlantic spotted dolphin	0.00	0.00	171.90	1.03	24.0	0	172
Atlantic white-sided dolphin	0.00	0.00	1793.83	2.79	19.1	0	1794
Common bottlenose dolphin	0.00	0.00	1616.59	200.96	13.0	0	1617
Common dolphin	0.00	0.00	32125.13	1685.03	24.3	0	32126
Pilot whale, long-finned	0.00	0.00	216.84	22.97	6.2	0	217
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	449.67	1.24	12.0	0	450
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	3.19	882.37	-	2.5	4	883
Pinnipeds (PPW hearing group)							
Gray seal	0.65	0.00	1040.50	13.63	1.4	1	1041
Harbor seal	0.02	0.01	95.73	2.75	1.4	1	96

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 57. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule B year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule B – Year 4 (2031)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	17.35	0.05	127.51	16.51	2.0	18	128
Humpback whale	16.04	0.00	103.38	29.60	2.2	17	104
Minke whale	67.93	0.15	404.69	13.31	1.4	68	405
North Atlantic right whale*	4.94	0.02	39.04	1.71	2.0	5	40
Sei whale*	1.37	0.00	13.22	3.20	1.7	2	14
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	24.02	-	2.0	0	25
Atlantic spotted dolphin	0.00	0.00	30.58	0.64	24.0	0	31
Atlantic white-sided dolphin	0.00	0.00	1354.56	1.73	19.1	0	1355
Common bottlenose dolphin	0.00	0.00	868.55	124.65	13.0	0	869
Common dolphin	0.00	0.00	14191.02	1045.14	24.3	0	14192
Pilot whale, long-finned	0.00	0.00	109.60	14.25	6.2	0	110
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	129.02	0.77	12.0	0	130
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.49	492.95	-	2.5	3	493
Pinnipeds (PPW hearing group)							
Gray seal	0.89	0.00	1028.00	8.46	1.4	1	1028
Harbor seal	0.03	0.00	63.69	1.70	1.4	1	64

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 58. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule B year 5 (2032), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate PTS SEL_{cum}	Modeled Exposure Estimate PTS SPL_{pk}	Modeled Exposure Estimate Behavior	PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule B – Year 5 (2032) Level A Take	Total Estimated Take Project 2 Max Schedule B – Year 5 (2032) Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	18.97	0.09	19.99	14.83	2.0	19	20
Humpback whale	16.34	0.00	20.30	26.58	2.2	17	27
Minke whale	72.53	0.10	132.75	11.95	1.4	73	133
North Atlantic right whale*	4.99	0.00	7.69	1.54	2.0	5	8
Sei whale*	1.29	0.00	3.46	2.87	1.7	2	4
Odontocetes (MF hearing group)							
Sperm whale*	0.00	0.00	14.64	-	2.0	0	15
Atlantic spotted dolphin	0.00	0.00	9.26	0.58	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	491.23	1.55	19.1	0	492
Common bottlenose dolphin	0.00	0.00	555.55	111.93	13.0	0	556
Common dolphin	0.00	0.00	9407.19	938.50	24.3	0	9408
Pilot whale, long-finned	0.00	0.00	51.20	12.80	6.2	0	52
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	63.04	0.69	12.0	0	64
Odontocetes (HF hearing group)							
Harbor porpoise	0.00	2.32	198.61	-	2.5	3	199
Pinnipeds (PPW hearing group)							
Gray seal	0.78	0.00	15.13	7.59	1.4	1	16
Harbor seal	0.01	0.00	6.75	1.53	1.4	1	7

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of piling days for this schedule and year.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10. The take estimate assumes one average group size per year of foundation installation.
[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

6.4 HRG Surveys

As described in Section 1.1.4, offshore and nearshore geophysical surveys are expected to be conducted within the Lease Area and OECCs for activities such as pre-lay surveys, verifying site conditions, ensuring proper installation of components, conducting as-built surveys, inspecting the depth of cable burial, and inspecting foundations. The final equipment used during the proposed HRG survey activities will vary depending on the final survey design, vessel availability, and survey contractor selection. In order to assess impacts of this activity, a selection of HRG equipment was used to estimate potential horizontal impact distances to regulatory-defined Level A and B harassment thresholds. The assessment assumed that the equipment would be similar to that used during previous and ongoing site assessments for which Vineyard Northeast has held Incidental Harassment Authorizations (e.g., NMFS-OPR 2023). Further details are provided in Section 6.4.2 below.

6.4.1 Marine Mammal Densities Used to Estimate Exposures Incidental to HRG Surveys

This analysis used the maximum density month during the year for each species, as a conservative measure to assure sufficient take is requested, assuming HRG surveys could occur during any month. The densities used in this assessment, shown in Table 59, are based on a 5 km perimeter around the Lease Area and OECCs. The perimeter is based on the largest range to the Level B sound exposure threshold (178 m) rounded up to 5 km, which is the size of the cells in the Roberts et al. (2016; 2023; 2024) density models. Densities in Table 59 are shown in units of animals/100 km^2 for readability. These were converted to animals/km^2 for exposure calculations.

Table 59. Maximum monthly marine mammal density (animals/100 km^2) in the Lease Area, Connecticut OECC, and Massachusetts OECC used to estimate exposures incidental to HRG surveys.

Species	Maximum Monthly Density (per 100 km^2)	Maximum Density Month
Mysticetes (LF hearing group)		
Fin whale*	0.330	July
Humpback whale	0.231	May
Minke whale	1.396	May
North Atlantic right whale*	0.643	February
Sei whale*	0.145	May
Odontocetes (MF hearing group)		
Sperm whale*	0.100	August
Atlantic spotted dolphin	0.445	October
Atlantic white-sided dolphin	2.633	May
Common bottlenose dolphin	1.468	August
Common dolphin	20.962	October
Pilot whale, long-finned	0.143	Annual
Pilot whale, short-finned	0.036	Annual
Risso's dolphin	0.193	February
Odontocetes (HF hearing group)		
Harbor porpoise	8.165	February
Pinnipeds (PPW hearing group)		
Gray seal	16.177	January
Harbor seal	3.260	January

* Indicates species listed as endangered under the US Endangered Species Act.

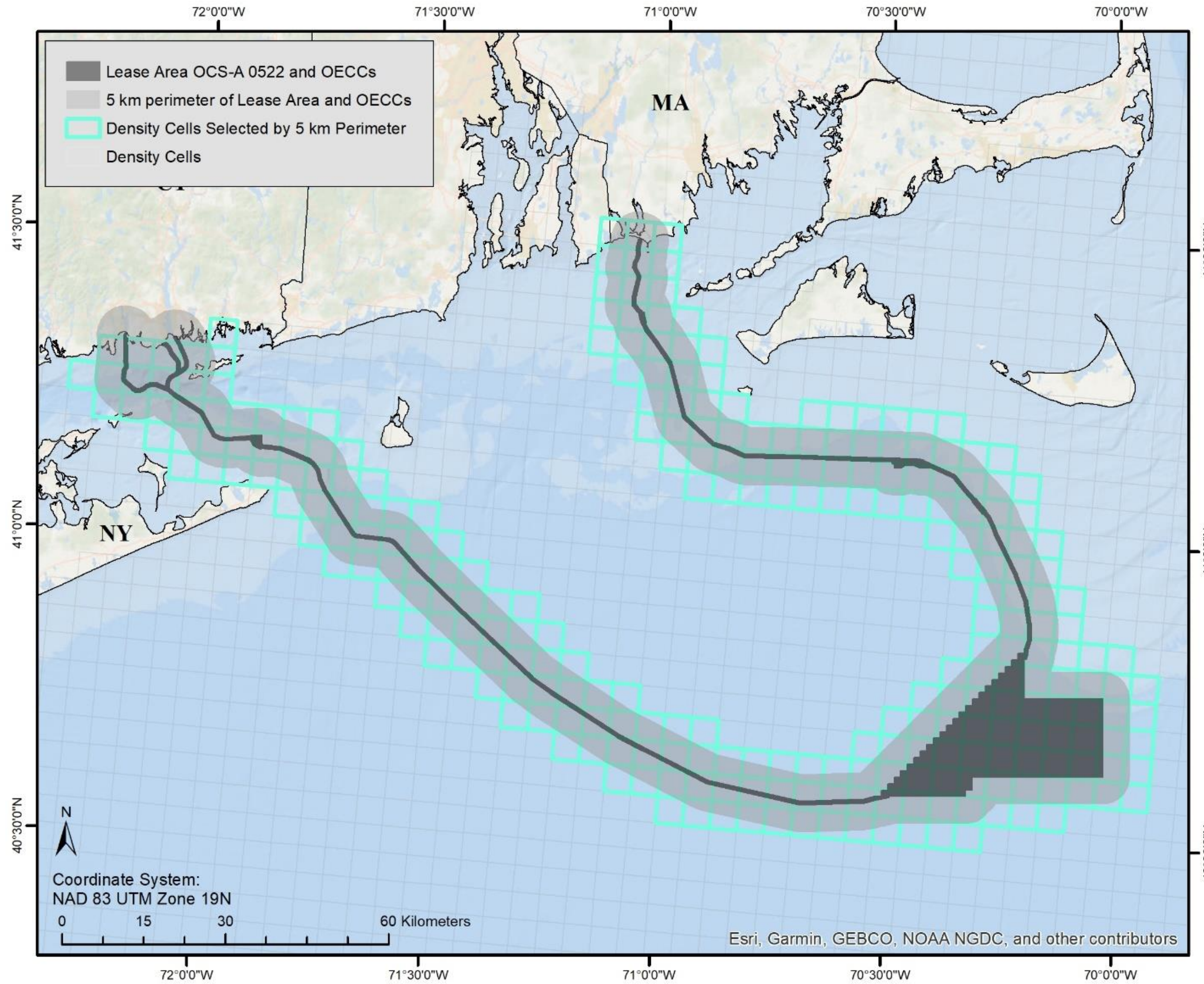

Figure 7. Map showing the marine mammal density model cells selected by a 5 km wide perimeter around Lease Area OCS-A 0522 and both OECCs.

6.4.2 Area Potentially Exposed to Sounds Above Threshold Levels from HRG Surveys

The final equipment used during the proposed HRG survey activities will vary depending on the final survey design, vessel availability, and survey contractor selection. The report detailing the rationale and calculation of distances to acoustic thresholds for the HRG survey sources used in this assessment (Li and Koessler 2024) is provided as Appendix C. Table A-2 of Appendix C provides a list of these HRG survey sources and their characteristics. The source level of 206 dB re 1 µPa m shown in Table A-2 of Appendix C for the Geo Spark towed at a depth of 1 m was used for the sparker. The list of potential HRG survey equipment expected to operate below 180 kHz that were assessed for potential acoustic impacts is provided in Table 60. Equipment that will be operated at frequencies higher than 180 kHz (e.g., multibeam echosounders and side scan sonars) are not included in this application as they operate at frequencies outside the hearing range of marine mammals. All the source parameters used to calculate horizontal impact distances are also provided in Table 60 and further detailed in Appendix C.

Table 60. List of representative HRG survey sound sources considered in this assessment that produce underwater sound at frequencies equal to or less than 180 kHz, and their acoustic characteristics. See Appendix C for detailed calculations.

						In-beam			Out-of-beam	
Equipment	Example System	Frequency (kHz)	Beam Width (°)	Pulse Duration (ms)	Repetition Rate (Hz)	Source Level (dB re 1 µPa m)	Peak Source Level (dB re 1 µPa m)	Correction (dB)	Source Level (dB re 1 µPa m)	Peak Source Level (dB re 1 µPa m)
Shallow subbottom profiler	EdgeTech Chirp 216	2–16	65	2	3.75	178	182	-8.1	169.9	173.9
Deep seismic profiler	Applied Acoustics AA251 Boomer	0.2–15	180	0.8	2	205	212	0.0	205.0	212.0
	GeoMarine Geo Spark 2000 (400 tip), 1 m tow depth	0.05–3	180	3.9	1	206	214	0.0	206.0	214.0

To be conservative, the calculations assumed that the boomer and sparker are omnidirectional, so a beam width of 180° was used.

Operational parameters (e.g., sound level, beam width, repetition rate, etc.) will vary during a survey depending on location and geophysical objectives, and therefore operational knowledge is required to select appropriate parameters and source levels to estimate the distances to regulatory thresholds. Where there is uncertainty, a precautionary and conservative approach was taken. A detailed explanation of the sources of parameter information is provided in Appendix C. In summary, the following hierarchy was used to select input into horizontal impact distance calculations, as directed by NMFS:

- For equipment that was measured in Crocker and Fratantonio (2016), the reported source level for the most likely operational parameters was selected;
- For equipment not measured in Crocker and Fratantonio (2016) and where manufacturer specifications were available but only partially contained the required calculation inputs, a closest proxy source was selected from the measurements in Crocker and Fratantonio (2016);
- For equipment that was not measured in Crocker and Fratantonio (2016) and where a proxy source could not be found in Crocker and Fratantonio (2016), manufacturer specifications or personal communications with manufacturers or equipment operators were used. Manufacturer specifications typically represent the maximum output of any source and do not always represent the most likely operational settings.

Table 61 lists the geophysical survey sources and the horizontal impact distances to the Level A threshold criteria. Deep seismic profilers were assessed with the impulsive source criteria. These criteria are provided in Table 11 above. Given the short distances to the Level A thresholds and the monitoring and mitigation measures to be implemented during the survey (Sections 11 and 13), acoustic exposures to regulatory-defined sound levels associated with injury are not anticipated, and therefore no Level A take is requested.

Table 62 presents the geophysical survey sources and the horizontal impact distances to the Level B threshold (i.e., 160 dB SPL_{rms}) reported with source levels computed over the duration of the pulse. As per NMFS guidance, the horizontal impact distance used to calculate the zone of influence (ZOI) and estimated exposures does not include a hearing integration period. The source levels computed over the pulse length are used in the ZOI and exposure calculations. As noted in Appendix C, to be conservative, the calculations assumed the sparker and boomer sources are omnidirectional and therefore the distance to threshold was calculated based on horizontally propagating energy. This assumption, which is made because the beam pattern is unknown, results in generally precautionary estimates of received levels, and in particular is likely to overestimate both PK and SPL.

The largest estimated distance to the Level B threshold is 200 m from a sparker. This distance was multiplied by two times the average daily survey distance, which is 80 km for surveys in the Lease Area and 55 km for surveys along the OECCs, and the area of a circle with radius 200 m was added to the result to calculate the daily ZOI (Table 63). The daily ZOI was then multiplied by the total number of expected survey days.

Table 61. Estimated horizontal distances to the Level A threshold criteria.

Equipment	Example System	Level A Horizontal Impact Distance (m) to PK Threshold				Level A Horizontal Impact Distance (m) to SEL Threshold				Impulsive Source
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	(Y/N)
Shallow subbottom profiler	EdgeTech Chirp 216	NA	NA	NA	NA	<1	<1	<1	<1	N
Deep seismic profiler	Applied Acoustics AA251 Boomer	-	-	3	-	<1	<1	53	<1	Y
	GeoMarine Geo Spark 2000 (400 tip)	-	-	4	-	<2	<1	4	<1	Y

Table 62. Estimated horizontal distances to the Level B threshold criterion (SPL_{rms} 160 dB).

Equipment	Example System	Frequency (kHz)	Beam Width (°)	Source Level (dB re 1 µPa m)	Level B Horizontal Impact Distance (m)
Shallow subbottom profiler	EdgeTech Chirp 216	2–16	65	169.9	4.3
Deep seismic profiler	Applied Acoustics AA251 Boomer	0.2–15	180	205.0	177.8
	GeoMarine Geo Spark 2000 (400 tip), 1 m tow depth	0.05–3	180	206.0	200.0

Table 63. Estimated daily zones of influence (ZOI) for HRG surveys in the three areas.

	Lease Area	CT OECC	MA OECC
Level B distance (km)	0.200	0.200	0.200
Survey distance (km/day)	80	55	55
Daily ZOI (km^2)	32.1	22.1	22.1

6.4.3 Exposure and Take Estimates Incidental to HRG Surveys

The daily ZOIs (in km^2) from Table 63 were multiplied by the total number of expected survey days in each survey area (Lease Area – 30 days; Connecticut OECC – 20 days; and Massachusetts OECC – 14 days) and the maximum monthly number of animals/km^2 from the Roberts et al. (2016; 2023; 2024) density models (Table 59) to arrive at total Level B exposure estimates incidental to HRG surveys. To ensure sufficient take is requested for this activity, the maximum density-based exposure estimates were compared with PSO data-based estimates and with average animal group size. The largest of these three exposure estimates was used as the take estimate. This comparison and the resulting take estimates for the Lease Area and the two OECCs are provided in Table 64. Marine mammal exposure and take estimates incidental to HRG surveys for the two schedules for the full buildout of Vineyard Northeast and for Project 1 and Project 2 separately are provided in the subsections below.

Table 64. Comparison of density- and PSO-based exposure estimates and average animal group sizes, and the resulting Level B take estimate incidental to HRG surveys in the Lease Area and in the two OECCs.

	Maximum Level B Density-based Exposure Estimate			PSO Data-based Estimate[a]			Mean Group Size[b]	Level B Take Estimate		
Species	**Lease Area**	**CT OECC**	**MA OECC**	**Lease Area**	**CT OECC**	**MA OECC**		**Lease Area**	**CT OECC**	**MA OECC**
Mysticetes (LF hearing group)										
Fin whale*	3.19	1.46	1.02	10.11	6.74	4.72	2.0	11	7	5
Humpback whale	2.22	1.02	0.72	18.12	12.08	8.46	2.2	19	13	9
Minke whale	13.45	6.18	4.32	8.15	5.43	3.80	1.4	14	7	5
North Atlantic right whale*	6.20	2.85	1.99	1.05	0.70	0.49	2.0	7	3	2
Sei whale*	1.40	0.64	0.45	1.96	1.31	0.91	1.7	2	2	2
Odontocetes (MF hearing group)										
Sperm whale*	0.97	0.44	0.31	-	-	-	2.0	2	2	2
Atlantic spotted dolphin	4.29	1.97	1.38	0.39	0.26	0.18	24.0	24	24	24
Atlantic white-sided dolphin	25.38	11.65	8.16	1.06	0.71	0.49	19.1	26	20	20
Common bottlenose dolphin	14.15	6.50	4.55	76.32	50.88	35.61	13.0	77	51	36
Common dolphin	202.03	92.76	64.93	639.88	426.59	298.61	24.3	640	427	299
Pilot whale, long-finned	1.38	0.63	0.44	8.72	5.82	4.07	6.2	9	7	7
Pilot whale, short-finned	0.35	0.16	0.11	-	-	-	8.0	8	8	8
Risso's dolphin	1.86	0.85	0.60	0.47	0.31	0.22	12.0	12	12	12
Odontocetes (HF hearing group)										
Harbor porpoise	70.00	36.13	25.29	-	-	-	2.5	70	37	26
Pinnipeds (PPW hearing group)										
Gray seal	155.91	71.58	50.11	5.18	3.45	2.42	1.4	156	72	51
Harbor seal	31.42	14.43	10.10	1.04	0.70	0.49	1.4	32	15	11

CT OECC = Connecticut Offshore Export Cable Corridor; MA OECC = Massachusetts Offshore Export Cable Corridor.
* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of days of survey activity in each of the three areas.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10.

6.4.3.1 Vineyard Northeast Full Buildout

For the full buildout of Vineyard Northeast, under Schedule A, it was assumed that 1) pre-construction HRG surveys would be conducted within the Lease Area and Connecticut OECC during year 1 (2028) and within the Lease Area and Massachusetts OECC during year 2 (2029) and that 2) post-construction HRG surveys would be conducted in the Lease Area and both OECCs during year 4 (2031). Under Schedule B, it was assumed that 1) pre-construction HRG surveys would be conducted within the Lease Area and Connecticut OECC during year 1 (2028) and within the Lease Area and Massachusetts OECC during year 2 (2029) and that 2) post-construction HRG surveys would be conducted in the Lease Area and both OECCs during year 5 (2032). The duration of survey activities using equipment operated at or below 180 kHz is summarized in Table 65. The resulting take estimates are provided in Table 66.

As described in Section 6.4.3, the Level B take estimates provided for the three survey areas in Table 64 are based on total survey days in each area – Lease Area (30 days), Connecticut OECC (20 days), and Massachusetts OECC (14 days). The yearly take estimates shown in Table 66 are based on the allocation of days into the different survey years as provided in Table 65. Therefore, the yearly take estimates for Schedule A Year 1 are the total take estimates for the Lease Area from Table 64 multiplied by 0.25 (i.e., 7.5/30 days) plus the total take estimates for the Connecticut OECC from Table 64 multiplied by 0.5 (i.e., 10/20 days). The yearly take estimates for Schedule A Year 2 are the total take estimates for the Lease Area from Table 64 multiplied by 0.25 (i.e., 7.5/30 days) plus the total take estimates for the Massachusetts OECC from Table 64 multiplied by 0.5 (i.e., 7/14 days). And the yearly take estimates for Schedule A Year 4 are the total take estimates for the Lease Area multiplied by 0.5 (i.e., 15/30 days) plus the total take estimates from the Connecticut OECC multiplied by 0.5 (i.e., 10/20 days) plus the total take estimates from the Massachusetts OECC multiplied by 0.5 (i.e., 7/14 days). Yearly take estimates for Schedule B were calculated using the same methodology. All estimates were rounded to an integer after multiplication.

Table 65. Number of days of pre- and post-construction HRG surveys[1] for the full buildout of Vineyard Northeast.

Location	Schedule A-Year 1 (2028)/ Schedule B-Year 1 (2028)	Schedule A-Year 2 (2029)/ Schedule B-Year 2 (2029)	Schedule A-Year 4 (2031)/ Schedule B-Year 5 (2032)
Lease Area	7.5	7.5	15
Connecticut OECC	10	-	10
Massachusetts OECC	-	7	7
Total	17.5	14.5	32

[1] Durations are for HRG surveys using equipment with operating frequencies below 180 kHz.

Table 66. Level B take estimates incidental to HRG surveys for the full buildout of Vineyard Northeast for the two proposed construction schedules.

Species	Level B Take Estimate – Full Buildout					
	Schedule A			Schedule B		
	Year 1 (2028)	Year 2 (2029)	Year 4 (2031)	Year 1 (2028)	Year 2 (2029)	Year 5 (2032)
Mysticetes (LF hearing group)						
Fin whale*	6	5	12	6	5	12
Humpback whale	11	9	21	11	9	21
Minke whale	7	6	13	7	6	13
North Atlantic right whale*	3	3	6	3	3	6
Sei whale*	2	2	3	2	2	3
Odontocetes (MF hearing group)						
Sperm whale*	2	2	3	2	2	3
Atlantic spotted dolphin	18	18	36	18	18	36
Atlantic white-sided dolphin	17	17	33	17	17	33
Common bottlenose dolphin	45	37	82	45	37	82
Common dolphin	374	310	683	374	310	683
Pilot whale, long-finned	6	6	12	6	6	12
Pilot whale, short-finned	6	6	12	6	6	12
Risso's dolphin	9	9	18	9	9	18
Odontocetes (HF hearing group)						
Harbor porpoise	36	31	67	36	31	67
Pinnipeds (PPW hearing group)						
Gray seal	75	65	140	75	65	140
Harbor seal	16	14	29	16	14	29

* Indicates species listed as endangered under the US Endangered Species Act.

6.4.3.2 Project 1

For Project 1, under Schedule A, it was assumed that pre-construction HRG surveys would be conducted within the Lease Area and Connecticut OECC during year 1 (2028) and that post-construction HRG surveys would be conducted in the Lease Area and Connecticut OECC during year 4 (2031). Under Schedule B, it was assumed that pre-construction HRG surveys would be conducted within the Lease Area and Connecticut OECC during year 1 (2028) and that post-construction HRG surveys would be conducted in the Lease Area and Connecticut OECC during year 5 (2032). The duration of survey activities using equipment operated at or below 180 kHz during Project 1 is summarized in Table 67. The estimated takes incidental to HRG surveys for Project 1 are provided in Table 68. These estimates for Project 1 include potential takes associated with surveys in the Lease Area for the 10 positions that overlap with Project 2. See Section 6.4.3.1 for a description of how the yearly take estimates shown in Table 68 were calculated from the total take estimates shown in Table 64 using the number of days in the Lease Area and Connecticut OECC shown in Table 67.

Table 67. Number of days of pre- and post-construction HRG surveys[1] for Project 1.

Location	Schedule A-Year 1 (2028)/ Schedule B-Year 1 (2028)	Schedule A-Year 4 (2031)/ Schedule B-Year 5 (2032)
Lease Area	8	8
Connecticut OECC	10	10
Total	18	18

[1] Durations are for HRG surveys using equipment with operating frequencies below 180 kHz.

Table 68. Level B take estimates incidental to HRG surveys for Project 1 for the two proposed construction schedules.

	Level B Take Estimate – Project 1			
	Schedule A		Schedule B	
Species	Year 1 (2028)	Year 4 (2031)	Year 1 (2028)	Year 5 (2032)
Mysticetes (LF hearing group)				
Fin whale*	7	7	7	7
Humpback whale	12	12	12	12
Minke whale	8	8	8	8
North Atlantic right whale*	4	4	4	4
Sei whale*	2	2	2	2
Odontocetes (MF hearing group)				
Sperm whale*	2	2	2	2
Atlantic spotted dolphin	24	24	24	24
Atlantic white-sided dolphin	20	20	20	20
Common bottlenose dolphin	46	46	46	46
Common dolphin	385	385	385	385
Pilot whale, long-finned	7	7	7	7
Pilot whale, short-finned	8	8	8	8
Risso's dolphin	12	12	12	12
Odontocetes (HF hearing group)				
Harbor porpoise	40	40	40	40
Pinnipeds (PPW hearing group)				
Gray seal	78	78	78	78
Harbor seal	16	16	16	16

* Indicates species listed as endangered under the US Endangered Species Act.

6.4.3.3 Project 2

For Project 2, under Schedule A, it was assumed that pre-construction HRG surveys would be conducted within the Lease Area and Massachusetts OECC during year 2 (2029) and that post-construction HRG surveys would be conducted in the Lease Area and Massachusetts OECC during year 4 (2031). Under Schedule B, it was assumed that pre-construction HRG surveys would be conducted within the Lease Area and Massachusetts OECC during year 2 (2029) and that post-construction HRG surveys would be conducted in the Lease Area and Massachusetts OECC during year 5 (2032). The duration of survey activities using equipment operated at or below 180 kHz during Project 2 is summarized in Table 69. The estimated takes incidental to HRG surveys for Project 2 are provided in Table 70. These estimates for Project 2 include potential takes associated with surveys in the Lease Area for the 10 positions that overlap with Project 1. See Section 6.4.3.1 for a description of how the yearly take estimates shown in Table 70 were calculated from the total take estimates shown in Table 64 using the number of days in the Lease Area and Massachusetts OECC shown in Table 69.

Table 69. Number of days of pre- and post-construction HRG surveys[1] for Project 2.

Location	Schedule A-Year 2 (2029)/ Schedule B-Year 2 (2029)	Schedule A-Year 4 (2031)/ Schedule B-Year 5 (2032)
Lease Area	8	8
Massachusetts OECC	7	7
Total	15	15

[1] Durations are for HRG surveys using equipment with operating frequencies below 180 kHz.

Table 70. Level B take estimates incidental to HRG surveys for Project 2 for the two proposed construction schedules.

	Level B Take Estimate – Project 2			
	Schedule A		Schedule B	
Species	Year 2 (2029)	Year 4 (2031)	Year 2 (2029)	Year 5 (2032)
Mysticetes (LF hearing group)				
Fin whale*	6	6	6	6
Humpback whale	10	10	10	10
Minke whale	7	7	7	7
North Atlantic right whale*	3	3	3	3
Sei whale*	2	2	2	2
Odontocetes (MF hearing group)				
Sperm whale*	2	2	2	2
Atlantic spotted dolphin	24	24	24	24
Atlantic white-sided dolphin	20	20	20	20
Common bottlenose dolphin	39	39	39	39
Common dolphin	321	321	321	321
Pilot whale, long-finned	7	7	7	7
Pilot whale, short-finned	8	8	8	8
Risso's dolphin	12	12	12	12
Odontocetes (HF hearing group)				
Harbor porpoise	34	34	34	34
Pinnipeds (PPW hearing group)				
Gray seal	68	68	68	68
Harbor seal	14	14	14	14

* Indicates species listed as endangered under the US Endangered Species Act.

6.5 UXO Detonations

As described in Section 1.1.5, it was assumed that there could be up to 10 UXOs that cannot be avoided, relocated, or disposed of by other methods and, therefore, may need to be detonated in place – two in the Lease Area, four in the Massachusetts OECC, and four in the Connecticut OECC. An acoustic modeling study was done to assess potential impacts of these detonations. The study modeled acoustic ranges to regulatory-defined sound exposure thresholds, which were used to calculate ensonified areas and density-based marine mammal exposures. The full study report is available in Appendix J of Appendix A. A summary of the methods and results is provided below.

6.5.1 Marine Mammal Densities Used to Estimate Exposures Incidental to UXO Detonation

UXO detonation, if required, would only be done during the June–October period to avoid times when North Atlantic right whale densities are greatest (see Section **Error! Reference source not found.**). The maximum density month for each species during this period was chosen, as a conservative measure, to provide a maximum exposure estimate. Densities were calculated from the Roberts et al. (2016; 2023; 2024) models using a 50-km perimeter around each of the OECCs and the Lease Area, which is the distance to which the modeled sound was propagated. The resulting densities used in the analysis of impacts incidental to UXO detonation are shown in Table 71 for the three locations. Densities in Table 71 are shown in units of animals/100 km^2 for readability. These were converted to animals/km^2 for exposure calculations.

Table 71. Maximum monthly marine mammal density (animals/100 km^2) during June–October in the Lease Area, Connecticut OECC, and Massachusetts OECC used to estimate exposures incidental to UXO detonation.

Species	Maximum Monthly Density (June–October)		
	Lease Area S1 & S2	CT OECC S5 & S6	MA OECC S3 & S4
Mysticetes (LF hearing group)			
Fin whale*	0.533	0.439	0.200
Humpback whale	0.444	0.319	0.145
Minke whale	1.495	1.116	0.862
North Atlantic right whale*	0.183	0.025	0.059
Sei whale*	0.092	0.061	0.025
Odontocetes (MF hearing group)			
Sperm whale*	0.179	0.104	0.046
Atlantic spotted dolphin	1.494	1.249	0.154
Atlantic white-sided dolphin	5.425	3.807	1.265
Common bottlenose dolphin	3.357	3.367	1.448
Common dolphin	44.787	34.395	9.419
Pilot whale, long-finned	0.417	0.272	0.070
Pilot whale, short-finned	0.104	0.068	0.017
Risso's dolphin	1.880	1.020	0.055
Odontocetes (HF hearing group)			
Harbor porpoise	2.424	0.331	1.513
Pinnipeds (PPW hearing group)			
Gray seal	8.519	11.388	28.401
Harbor seal	1.717	2.295	5.724

* Indicates species listed as endangered under the US Endangered Species Act.

6.5.2 Area Potentially Exposed to Sounds Above Threshold Levels from UXO Detonation

The acoustic modeling study modeled UXO detonations at two modeling sites in each of the three locations where UXO detonation could occur (Figure 8). S1 and S2 are in the Lease Area, S3 and S4 are along the Massachusetts OECC, and S5 and S6 are along the Connecticut OECC. The model assumed one detonation at each site within the Lease Area and two detonations at each site within the OECCs, for a total of 10 possible detonations. As noted in Section 1.2.4, UXOs with more net explosive weight produce higher peak pressures. The US Navy has established twelve categories, or "bins", of charge weights to assess impacts of explosives, characterized by their equivalent trinitrotoluene (TNT) masses (DoN 2017). Because the type and net explosive weight of UXOs that may be detonated are unknown at this time, two of these charge mass bins were chosen as representative of UXOs that might be encountered – bin E10, with a maximum TNT equivalent mass of 227 kilograms ([kg], 500 pounds [lbs]), and bin E12, with a maximum TNT equivalent mass of 454 kg (1,000 lbs). Both bin sizes were modeled at each of the six sites. For the purpose of estimating exposures, the largest bin size (E12) was used. Results from the acoustic modeling for the E10 charge mass bin are available in Appendix J of Appendix A. The acoustic ranges and exposure results below are based on the E12 charge mass bin. Vineyard Northeast anticipates using mitigation technology (e.g., bubble curtain system or other system) during UXO detonations that will reduce received levels by 10 dB at all frequencies (see Section **Error! Reference source not**

found.). Therefore, the results below assume 10 dB of broadband sound mitigation. For reference, results without sound mitigation are available in Appendix J of Appendix A.

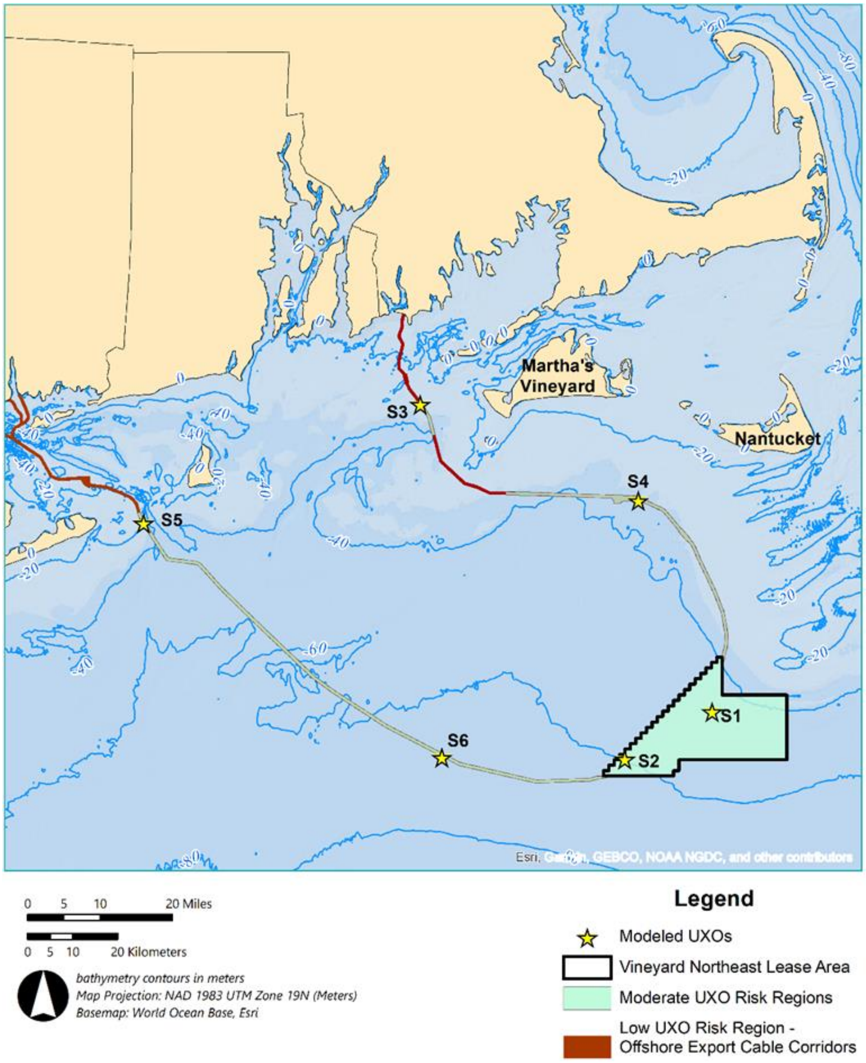

Figure 8. Map showing locations of the six UXO modeling sites along the two offshore export cable corridors and within the Lease Area. Reproduced from Figure J-1 (Appendix J of Appendix A).

6.5.2.1 Summary of Methods Used for Acoustic Modeling of UXO Detonation

Inputs to the acoustic model included the geoacoustic properties of the sediment in the Lease Area and OECCs and the sound speed profile based on water temperature, salinity, and depth. Monthly sound speed profiles for the months of March through November were derived using the US Navy's Generalized Digital Environmental Model (NAVO 2003). The March sound speed profile was selected for use in the propagation modeling because it is slightly upward-refracting at the deeper sites and is therefore expected to produce the most conservative (i.e., the longest) acoustic range estimates. As can be seen in Figure J-2 of Appendix A, the monthly sound speed profiles progressively differ from each other, thus using an average of the months when UXO detonation could occur could lead to non-conservative results.

Therefore, the March sound speed profile was selected based on the theory of underwater acoustic propagation in which an upward-refracting profile leads to fewer interactions with the bottom (where sound energy is lost through absorption) and therefore longer propagation distances. Additional details are provided in Appendix J of Appendix A.

Modeling of acoustic fields generated by UXO detonations is performed using a combination of semi-empirical and physics-based computational models. The source pressure function used for estimating the peak sound pressure (L_{pk}) and acoustic impulse (J_p) metrics is calculated using a semiempirical model that approximates the rapid conversion (within approximately 1 microsecond [μs] for high explosive) of solid explosive to gaseous form in a small gas bubble under high pressure, followed by an exponential pressure decay as that bubble expands. This behavior imparts an initial pressure "shock pulse" into the water that is commonly approximated by an instantaneous rise to peak pressure followed by an exponentially decaying pressure function. Close to the source (within tens of meters), the shape and amplitude of the pressure versus time signature of the shock pulse changes with distance from the detonation location due to non-linear propagation effects caused by its high peak pressure. Beyond a certain distance, there is a gradual transition to linear pressure decay, so alternative formulae are used beyond those distances to a point where the sound pressure decay with range transitions to the spherical spreading model. The acoustic impulse (J_p) is the integral of pressure through time. The modeling used the methods of the US Navy whereby an integration time window is applied starting at the onset of the shock pulse and ending at the lesser of the arrival time of the surface reflection and 20% of the oscillation period of an exposed animal's lung (DoN 2017).

SEL and SPL calculations for blast pressure waveforms depend on the characteristics of the initial shock pulse and the subsequent oscillation of the detonation gas bubble. The oscillations lead to a series of alternating negative and positive pressure phases trailing the initial positive pressure shock pulse. The positive pressures (relative to hydrostatic pressure) occur when the bubble volume is at its minima, and the negative pressures occur when the bubble volume is at its maxima. The shape of the resulting pressure waveform can be calculated using an explosive waveform model that includes the shock pulse model and extends the pressure prediction in time through several oscillations of the bubble. The modeling of SEL was carried out in decidecade frequency bands using JASCO's marine operations noise model (MONM).

6.5.2.2 Modeled Acoustic Ranges

As noted above, because the type and net explosive weight of UXOs that may be detonated are unknown at this time, two of the US Navy charge mass bins were chosen for the acoustic modeling. As a conservative assumption, the larger of these bins (E12, maximum TNT equivalent mass of 454 kg [1,000 lbs]) was used in the impact assessment. Thus, the acoustic range results presented below are all for the largest, E12, bin size. Results for charge mass bin E10 are available in Appendix J of Appendix A.

As described in Section 6.2, potential Level A harassment of marine mammals from underwater explosions is assessed using separate criteria for mortality, non-auditory injury, gastrointestinal injury, and auditory injury. Table 72 and Table 73 show the acoustic ranges to the mortality and non-auditory (lung) injury thresholds, respectively, for the six modeled sites, with 10 dB of sound attenuation. The modeled acoustic range to gastrointestinal injury was 125.8 m for all sites (see Table J-45 of Appendix A). Table 74 provides the modeled acoustic ranges to the Level A (PTS onset) and Level B (TTS onset) frequency-weighted SEL thresholds, for detonation of one UXO with an E12 charge weight at each of the six modeled sites, with 10 dB of sound attenuation. The Level A PTS onset and Level B TTS onset peak thresholds are also shown in Table 74, for comparison. All peak ranges were lower than SEL ranges, so SEL ranges are used in the analysis. In all cases, distances to mortality (Table 72), non-auditory lung injury (Table 73), and gastrointestinal injury (125.8 m) thresholds were shorter than those to frequency-weighted SEL auditory injury thresholds (Table 74). Because the mitigation and monitoring measures described in Sections 11 and 13 are designed to avoid mortality and non-auditory injuries (as well as potential auditory injury), only the auditory injury (PTS onset) SEL threshold distances are used for the calculation of potential Level A takes.

Table 72. Impulse acoustic ranges (in meters) to the onset of mortality thresholds for the largest UXO charge weight (E12) for the six modeling sites, with 10 dB of attenuation from the use of NAS. Thresholds are based on animal mass and submersion depth (see Appendix J of Appendix A).

	Acoustic Range (m) to Mortality Level A Threshold					
	Lease Area		CT OECC		MA OECC	
Marine Mammal Group	**S1**	**S2**	**S5**	**S6**	**S3**	**S4**
Adults						
Large mysticetes and sperm whales	30	28	32	27	32	31
Minke whales and pilot whales	51	47	58	45	57	56
Dolphins and pinnipeds	226	230	208	232	213	217
Porpoises	246	255	224	255	232	238
Calves/pups						
Large mysticetes and sperm whales	110	106	108	102	110	110
Minke whales and pilot whales	164	166	156	164	159	161
Dolphins and pinnipeds	334	348	298	353	309	316
Porpoises	356	370	321	383	332	344

Table 73. Impulse acoustic ranges (in meters) to the onset of non-auditory (lung) injury thresholds for the largest UXO charge weight (E12) for the six modeling sites, with 10 dB of attenuation from the use of NAS. Thresholds are based on animal mass and submersion depth (see Appendix J of Appendix A).

	Acoustic Range (m) to Lung Injury Onset Level A Threshold					
	Lease Area		CT OECC		MA OECC	
Marine Mammal Group	**S1**	**S2**	**S5**	**S6**	**S3**	**S4**
Adults						
Large mysticetes and sperm whales	79	71	82	68	82	82
Minke whales and pilot whales	134	132	130	130	132	133
Dolphins and pinnipeds	432	455	388	466	402	413
Porpoises	470	492	416	504	431	448
Calves/pups						
Large mysticetes and sperm whales	240	245	222	246	228	233
Minke whales and pilot whales	333	344	302	351	312	320
Dolphins and pinnipeds	609	645	540	667	560	582
Porpoises	654	700	577	715	596	619

Table 74. Acoustic ranges ($R_{95\%}$) to PTS (Level A) and TTS (Level B) onset frequency-weighted SEL thresholds for detonation of one E12 UXO at the six sites, with 10 dB attenuation, used in exposure estimates. For comparison, the PTS and TTS onset peak ranges are also shown.

		Range (m) to PTS Onset - SEL						Range (m) to PTS Onset - L_{pk}	
	Level A	Lease Area		CT OECC		MA OECC		Level A	All
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4	Threshold	Sites
Low-frequency cetacean	183	3,840	4,000	5,420	3,960	4,110	3,870	219	852.1
Mid-frequency cetacean	185	238	222	366	226	319	287	230	262.6
High-frequency cetacean	155	6,470	7,530	9,030	6,540	7,580	7,490	202	5405.5
Phocid pinniped in water	185	1,320	1,240	1,880	1,250	1,550	1,410	218	948.9
		Range (m) to TTS Onset - SEL						Range (m) to TTS Onset - L_{pk}	
	Level B	Lease Area		CT OECC		MA OECC		Level A	All
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4	Threshold	Sites
Low-frequency cetacean	168	18,500	20,200	32,900	20,500	21,300	18,200	213	1630.0
Mid-frequency cetacean	170	2,200	2,180	3,620	2,250	2,380	2,330	224	497.7
High-frequency cetacean	140	24,600	25,400	31,300	24,200	25,900	25,200	196	10437.7
Phocid pinniped in water	170	9,260	9,400	12,700	9,220	10,100	9,360	212	1816.8

Areas ensonified above the PTS and TTS frequency-weighted SEL acoustic ranges from Table 74 were calculated using the acoustic ranges in Table 74 and the equation $A = \pi r^2$. These areas, which are provided in Table 75, were used to calculate the density-based marine mammal exposures provided in Section 6.5.3.

Table 75. Areas (km^2) ensonified to PTS (Level A) and TTS (Level B) onset (frequency-weighted SEL) levels from detonation of one E12 UXO at the six sites, with 10 dB attenuation, used in exposure estimates.

		Area (km^2) Ensonified to Level A Threshold					
	Level A	Lease Area		CT OECC		MA OECC	
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4
Low-frequency cetacean	183	48.32	51.48	56.96	51.96	51.05	49.31
Mid-frequency cetacean	185	0.19	0.16	0.44	0.17	0.33	0.27
High-frequency cetacean	155	136.68	146.59	180.55	141.28	172.41	160.11
Phocid pinniped in water	185	5.73	5.10	9.10	5.19	7.85	6.59
		Area (km^2) Ensonified to Level B Threshold					
	Level B	Lease Area		CT OECC		MA OECC	
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4
Low-frequency cetacean	168	942.75	1,059.81	1,420.76	1,141.65	920.89	920.25
Mid-frequency cetacean	170	16.03	14.93	23.85	14.86	18.63	17.89
High-frequency cetacean	140	1,708.18	1,698.37	1,879.28	1,592.98	1,465.74	1,619.26
Phocid pinniped in water	170	225.06	245.34	303.57	266.48	275.88	254.30

6.5.3 Exposure and Take Estimates Incidental to UXO Detonations

The ensonified areas (in km^2) from Table 75 were multiplied by the June–October maximum monthly densities of marine mammals (animals/km^2) from the Roberts et al. (2016; 2023; 2024) density models (Table 71) to arrive at density-based Level A and Level B exposure estimates incidental to detonation of one UXO at each of the modeled locations. These are shown in Table 76 and Table 77, respectively. Based on the available information, up to two UXO detonations may be necessary within the Lease Area and up to four UXO detonations may be necessary within each of the OECCs, for 10 total detonations. It was assumed that one of the detonations within the Lease Area could occur at each of the modeled sites and that two UXO detonations could occur at each of the OECC modeled sites. Thus, to arrive at take estimates, the exposure estimates for the OECC modeling sites in Table 76 and Table 77 were multiplied by two prior to summing areas all six modeling sites. Table 78 provides maximum exposure and take estimates incidental to UXO detonation for each of the areas. This table also provides the PSO data-based estimate and mean group size used in the Level B take calculations for this activity. As shown in Table 78, Level B take estimates for all mid-frequency odontocetes are based on average group size, except for common dolphins, which are based on PSO data. All other Level B take estimates (mysticetes, high-frequency odontocetes, and pinnipeds) are density-based. The one exception is for sei whales for which the Level B take estimate for the Massachusetts OECC is based on group size.

Table 76. Level A (PTS onset, SEL threshold) marine mammal exposure estimates incidental to UXO detonation, for a single detonation at each of the modeled sites, using the highest density month and assuming 10 dB of sound attenuation.

	Level A (PTS SEL) Exposure Estimate					
	Lease Area		CT OECC		MA OECC	
Species	**S1**	**S2**	**S5**	**S6**	**S3**	**S4**
Mysticetes (LF hearing group)						
Fin whale*	0.26	0.27	0.25	0.23	0.10	0.10
Humpback whale	0.21	0.23	0.18	0.17	0.07	0.07
Minke whale	0.72	0.77	0.64	0.58	0.44	0.43
North Atlantic right whale*	0.09	0.09	0.01	0.01	0.03	0.03
Sei whale*	0.04	0.05	0.03	0.03	0.01	0.01
Odontocetes (MF hearing group)						
Sperm whale*	0.01	0.01	0.01	0.01	0.01	0.01
Atlantic spotted dolphin	0.01	0.01	0.01	0.01	0.01	0.01
Atlantic white-sided dolphin	0.01	0.01	0.02	0.01	0.01	0.01
Common bottlenose dolphin	0.01	0.01	0.01	0.01	0.01	0.01
Common dolphin	0.09	0.07	0.15	0.06	0.03	0.03
Pilot whale, long-finned	0.01	0.01	0.01	0.01	0.01	0.01
Pilot whale, short-finned	0.01	0.01	0.01	0.01	0.01	0.01
Risso's dolphin	0.00	0.00	0.00	0.00	0.00	0.00
Odontocetes (HF hearing group)						
Harbor porpoise	3.31	3.55	0.60	0.47	2.61	2.42
Pinnipeds (PPW hearing group)						
Gray seal	0.49	0.43	1.04	0.59	2.23	1.87
Harbor seal	0.10	0.09	0.21	0.12	0.45	0.38

* Indicates species listed as endangered under the US Endangered Species Act.

Table 77. Level B (TTS onset, SEL threshold) marine mammal exposure estimates incidental to UXO detonation, for a single detonation at each of the modeled sites, using the highest density month and assuming 10 dB of sound attenuation.

	Level B (TTS SEL) Exposure Estimate					
	Lease Area		CT OECC		MA OECC	
Species	S1	S2	S5	S6	S3	S4
Mysticetes (LF hearing group)						
Fin whale*	5.02	5.65	6.24	5.01	1.84	1.84
Humpback whale	4.19	4.71	4.53	3.64	1.34	1.33
Minke whale	14.09	15.84	15.86	12.74	7.94	7.93
North Atlantic right whale*	1.73	1.94	0.36	0.29	0.54	0.54
Sei whale*	0.87	0.98	0.87	0.70	0.23	0.23
Odontocetes (MF hearing group)						
Sperm whale*	0.03	0.03	0.02	0.02	0.01	0.01
Atlantic spotted dolphin	0.24	0.22	0.30	0.19	0.03	0.03
Atlantic white-sided dolphin	0.87	0.81	0.91	0.57	0.24	0.23
Common bottlenose dolphin	0.53	0.49	0.60	0.37	0.21	0.21
Common dolphin	7.18	6.69	8.20	5.11	1.75	1.69
Pilot whale, long-finned	0.07	0.06	0.06	0.04	0.01	0.01
Pilot whale, short-finned	0.02	0.02	0.02	0.01	0.01	0.01
Risso's dolphin	0.30	0.28	0.24	0.15	0.01	0.01
Odontocetes (HF hearing group)						
Harbor porpoise	41.41	41.17	6.22	5.27	22.18	24.50
Pinnipeds (PPW hearing group)						
Gray seal	19.17	20.90	34.57	30.35	78.35	72.22
Harbor seal	3.86	4.21	6.97	6.12	15.79	14.56

* Indicates species listed as endangered under the US Endangered Species Act.

Table 78. Maximum Level A and Level B exposure and take estimates[c] incidental to UXO detonation in the Lease Area, Connecticut OECC, and Massachusetts OECC, with 10 dB sound attenuation. Assumes two detonations in the Lease Area and four detonations in each of the OECCs.

	Maximum Density-based Exposure Estimate						PSO Data-based Estimate[a]		Mean Group Size[b]	Maximum Take Estimate					
	Lease Area		CT OECC		MA OECC					Lease Area		CT OECC		MA OECC	
Species	Level A	Level B	Level A	Level B	Level A	Level B	LA	OECCs		Level A	Level B	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)															
Fin whale*	0.53	10.67	0.96	22.50	0.40	7.36	0.67	1.35	2.0	1	11	1	23	1	8
Humpback whale	0.44	8.90	0.70	16.34	0.28	5.34	1.21	2.42	2.2	1	9	1	17	1	6
Minke whale	1.49	29.93	2.44	57.20	1.74	31.74	0.54	1.09	1.4	2	30	3	58	2	32
North Atlantic right whale*	0.18	3.67	0.04	1.30	0.12	2.16	0.07	0.14	2.0	1	4	1	2	1	3
Sei whale*	0.09	1.85	0.12	3.14	0.04	0.92	0.13	0.26	1.7	1	2	1	4	1	2
Odontocetes (MF hearing group)															
Sperm whale*	0.02	0.06	0.04	0.08	0.04	0.04	-	-	2.0	1	2	1	2	1	2
Atlantic spotted dolphin	0.02	0.46	0.04	0.98	0.04	0.12	0.03	0.05	24.0	1	24	1	24	1	24
Atlantic white-sided dolphin	0.02	1.68	0.06	2.96	0.04	0.94	0.07	0.14	19.1	1	20	1	20	1	20
Common bottlenose dolphin	0.02	1.02	0.04	1.94	0.04	0.84	5.09	10.18	13.0	1	14	1	14	1	14
Common dolphin	0.16	13.87	0.42	26.62	0.12	6.88	42.66	85.32	24.3	1	43	1	86	1	86
Pilot whale, long-finned	0.02	0.13	0.04	0.20	0.04	0.04	0.58	1.16	6.2	1	7	1	7	1	7
Pilot whale, short-finned	0.02	0.04	0.04	0.06	0.04	0.04	-	-	8.0	1	8	1	8	1	8
Risso's dolphin	0.00	0.58	0.00	0.78	0.00	0.04	0.03	0.06	12.0	0	12	0	12	0	12
Odontocetes (HF hearing group)															
Harbor porpoise	6.86	82.58	2.14	22.98	10.06	93.36	-	-	2.5	7	83	3	23	11	94
Pinnipeds (PPW hearing group)															
Gray seal	0.92	40.07	3.26	129.84	8.20	301.14	0.35	0.69	1.4	1	41	4	130	9	302
Harbor seal	0.19	8.07	0.66	26.18	1.66	60.70	0.07	0.14	1.4	1	9	1	27	2	61

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of detonations in the Lease Area and OECCs.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10.
c Level B take estimates for all mid-frequency odontocetes are based on average group size, except for common dolphins, which are based on PSO data. All other Level B take estimates (mysticetes, high-frequency odontocetes, and pinnipeds) are density-based. The one exception to this is for sei whales for which the Level B take estimate for the Massachusetts OECC is based on group size.

6.5.3.1 Vineyard Northeast Full Buildout

Marine mammal exposure and maximum take estimates incidental to UXO detonation for the full buildout of Vineyard Northeast are provided in Table 79. Under Schedule A, all detonations within the Lease Area as well as the two OECCs will occur during Year 2 (2029) of the requested authorization. Under Schedule B, UXO detonations for the northeastern portion of the Lease Area as well as the Connecticut OECC will occur during Year 1 (2028) and detonations for the southwestern portion of the Lease Area as well as the Massachusetts OECC will occur during Year 3 (2030).

Table 79. Marine mammal exposure and maximum take estimates incidental to UXO detonation for the full buildout of Vineyard Northeast for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A				Schedule B									
	Year 2 (2029)				Year 1 (2028)				Year 3 (2030)				Both Years	
	Exposures		Takes[a]		Exposures		Takes[a]		Exposures		Takes[a]		Total Takes[b]	
Species	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)														
Fin whale*	1.89	40.53	2	41	1.22	27.52	2	28	0.67	13.01	1	14	3	42
Humpback whale	1.42	30.58	2	31	0.91	20.53	1	21	0.51	10.05	1	11	2	32
Minke whale	5.67	118.87	6	119	3.16	71.29	4	72	2.51	47.58	3	48	7	120
North Atlantic right whale*	0.34	7.13	1	8	0.13	3.03	1	4	0.21	4.10	1	5	2	9
Sei whale*	0.25	5.91	1	6	0.16	4.01	1	5	0.09	1.90	1	2	2	7
Odontocetes (MF hearing group)														
Sperm whale*	0.10	0.18	1	2	0.05	0.11	1	2	0.05	0.07	1	2	2	4
Atlantic spotted dolphin	0.10	1.56	1	24	0.05	1.22	1	24	0.05	0.34	1	24	2	48
Atlantic white-sided dolphin	0.12	5.58	1	20	0.07	3.83	1	20	0.05	1.75	1	20	2	40
Common bottlenose dolphin	0.10	3.80	1	26	0.05	2.47	1	14	0.05	1.33	1	14	2	28
Common dolphin	0.70	47.37	1	214	0.51	33.80	1	107	0.19	13.57	1	107	2	214
Pilot whale, long-finned	0.10	0.37	1	7	0.05	0.27	1	7	0.05	0.10	1	7	2	14
Pilot whale, short-finned	0.10	0.14	1	8	0.05	0.08	1	8	0.05	0.06	1	8	2	16
Risso's dolphin	0.00	1.40	0	12	0.00	1.08	0	12	0.00	0.32	0	12	0	24
Odontocetes (HF hearing group)														
Harbor porpoise	19.06	198.92	20	199	5.45	64.39	6	65	13.61	134.53	14	135	20	200
Pinnipeds (PPW hearing group)														
Gray seal	12.38	471.05	13	472	3.75	149.01	4	150	8.63	322.04	9	323	13	473
Harbor seal	2.51	94.95	3	95	0.76	30.04	1	31	1.75	64.91	2	65	3	96

[a] Level B takes are the maximum of the modeled exposure estimate, PSO data-based estimate (last column of Table 9 multiplied by the number of detonations), and mean group size (Table 10) multiplied by number of detonations, and therefore may be greater than the Level B exposures shown in this table.

[b] The sum of the take for the two years under Schedule B is greater than the total take under Schedule A because exposure estimates for the different areas were rounded in each year prior to being summed. This method was deemed most appropriate because the exposures occur in different years and are therefore independent events. Under Schedule A, all take occurs during a single year, so the exposure estimates are rounded only once. Under Schedule B, the table shows exposure estimates rounded up for each of the two years separately, so summing these yearly take estimates after each has been rounded up results in higher total take estimates for this schedule.

* Indicates species listed as endangered under the US Endangered Species Act.

6.5.3.2 Project 1

It is expected that the northeastern portion of the Lease Area and the Connecticut OECC will be built out first and thus estimated takes from UXO modeling sites S1, S5, and S6 are attributed to Project 1. The maximum take estimates incidental to UXO detonation for Project 1 are provided in Table 80. Under Schedule A, these takes would occur during Year 2 (2029) and under Schedule B, these takes would occur during Year 1 (2028).

Table 80. Maximum marine mammal take estimates incidental to UXO detonation for Project 1 for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A		Schedule B	
	Year 2 (2029)		Year 1 (2028)	
Species	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)				
Fin whale*	2	28	2	28
Humpback whale	1	21	1	21
Minke whale	4	72	4	72
North Atlantic right whale*	1	4	1	4
Sei whale*	1	5	1	5
Odontocetes (MF hearing group)				
Sperm whale*	1	2	1	2
Atlantic spotted dolphin	1	24	1	24
Atlantic white-sided dolphin	1	20	1	20
Common bottlenose dolphin	1	14	1	14
Common dolphin	1	107	1	107
Pilot whale, long-finned	1	7	1	7
Pilot whale, short-finned	1	8	1	8
Risso's dolphin	0	12	0	12
Odontocetes (HF hearing group)				
Harbor porpoise	6	65	6	65
Pinnipeds (PPW hearing group)				
Gray seal	4	150	4	150
Harbor seal	1	31	1	31

* Indicates species listed as endangered under the US Endangered Species Act.

6.5.3.3 Project 2

It is expected that the southwestern portion of the Lease Area and the Massachusetts OECC will be built out after Project 1 and thus estimated takes from UXO modeling sites S2, S3, and S4 are attributed to Project 2. The maximum take estimates incidental to UXO detonation for Project 2 are provided in Table 81. Under Schedule A these takes would occur during Year 2 (2029) and under Schedule B these takes would occur during Year 3 (2030).

Table 81. Maximum marine mammal take estimates incidental to UXO detonation for Project 2 for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A		Schedule B	
	Year 2 (2029)		Year 3 (2030)	
Species	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)				
Fin whale*	1	14	1	14
Humpback whale	1	11	1	11
Minke whale	3	48	3	48
North Atlantic right whale*	1	5	1	5
Sei whale*	1	2	1	2
Odontocetes (MF hearing group)				
Sperm whale*	1	2	1	2
Atlantic spotted dolphin	1	24	1	24
Atlantic white-sided dolphin	1	20	1	20
Common bottlenose dolphin	1	14	1	14
Common dolphin	1	107	1	107
Pilot whale, long-finned	1	7	1	7
Pilot whale, short-finned	1	8	1	8
Risso's dolphin	0	12	0	12
Odontocetes (HF hearing group)				
Harbor porpoise	14	135	14	135
Pinnipeds (PPW hearing group)				
Gray seal	9	323	9	323
Harbor seal	2	65	2	65

* Indicates species listed as endangered under the US Endangered Species Act.

6.6 Landfall Site Cofferdam Installation/Removal

As described in Section 1.1.3, at each OECC landfall site, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD). HDD is a trenchless installation method that avoids or minimizes impacts to the beach, intertidal zone, and nearshore areas. Prior to drilling, an offshore exit pit is excavated (one exit pit is needed for each offshore export cable/cable bundle). At the HDD offshore exit pit, a temporary cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial. If used, the cofferdams will be constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. Up to two cofferdams could be installed at the Connecticut landfall site and up to three cofferdams could be installed at the Massachusetts landfall site. The cofferdams would also be removed likely using a vessel-mounted crane and vibratory hammer.

Other than the installation of cofferdams using a vibratory hammer, HDD is not expected to result in marine mammal take.

In order to assess the potential impacts of installation and removal of temporary cofferdams at the landfall sites, a study was conducted that involved modeling acoustic ranges and calculating density-based marine mammal exposure estimates. Full details can be found in Appendix K of Appendix A. Two modeling sites were used: L01 (Connecticut) and L02 (Massachusetts). The methods and results are summarized below.

6.6.1 Marine Mammals Densities Used to Estimate Exposures Incidental to Landfall Site Cofferdam Installation/Removal

As noted in Section 6.1.1, marine mammal densities in the potential impact area were estimated using the MGEL/Duke University Habitat-based Marine Mammal Density Models for the US Atlantic (Roberts et al. 2016; 2023; 2024). The Duke density models include grid cells extending into coastal areas within the predicted ZOI for cofferdam installation and are the best available densities for the US Atlantic. Density perimeters were based on the longest 95th percentile acoustic range ($R_{95\%}$) to threshold at each modeled site: 6.7 km (4.2 mi) for site L01 (Connecticut) and 8 km (5.0 mi) for site L02 (Massachusetts). See Figures K-4 and K-5 of Appendix A. For the Connecticut cofferdam site, the perimeter was drawn around all three potential landfall sites (see Figure K-4 of Appendix A). Monthly densities were calculated as the average of the densities from all MGEL/Duke model grid cells that overlap partially or completely with each area of interest. Cells entirely on land were not included, but cells that overlap only partially with land were included. This analysis used the maximum density month during summer (April–November) and winter (December–March) for each species, as a conservative measure to assure sufficient take is requested, assuming cofferdam installation/removal could occur during any of these months. The densities used in this assessment are shown in Table 82 for the summer and winter seasons. Densities in Table 82 are shown in units of animals/100 km^2 for readability. These were converted to animals/km^2 for exposure calculations.

Table 82. Maximum monthly densities (animals/100 km^2) used to calculate Level B exposures incidental to vibratory hammering during cofferdam installation for summer and winter and for the two modeled sites. Adapted from Table K-5 of Appendix A.

	Maximum Monthly Density			
	Summer (April–November)		Winter (December–March)	
Species	L01	L02	L01	L02
Mysticetes (LF hearing group)				
Fin whale*	0.006	0.019	0.009	0.022
Humpback whale	0.055	0.041	0.057	0.030
Minke whale	0.219	0.217	0.002	0.029
North Atlantic right whale*	0.014	0.054	0.034	0.076
Sei whale*	0.015	0.036	0.023	0.030
Odontocetes (MF hearing group)				
Sperm whale*	0.019	0.003	0.012	0.003
Atlantic spotted dolphin	<0.001	0.015	<0.001	<0.001
Atlantic white-sided dolphin	0.494	0.097	0.446	0.069
Common bottlenose dolphin	0.048	0.174	0.028	0.096
Common dolphin	1.461	1.105	1.114	0.935
Pilot whale, long-finned	<0.001	<0.001	<0.001	<0.001
Pilot whale, short-finned	<0.001	<0.001	<0.001	<0.001
Risso's dolphin	<0.001	0.013	<0.001	0.013
Odontocetes (HF hearing group)				
Harbor porpoise	1.254	1.291	1.951	2.074
Pinnipeds (PPW hearing group)				
Gray seal	9.814	18.509	8.413	18.470
Harbor seal	1.978	3.731	1.696	3.723

* Indicates species listed as endangered under the US Endangered Species Act.
L01 = Connecticut and L02 = Massachusetts

6.6.2 Area Potentially Exposed to Sounds Above Threshold Levels from Vibratory Hammering During Cofferdam Installation and Removal

Acoustic ranges were modeled for cofferdam installation/removal at the Connecticut and Massachusetts landfall sites. The acoustic modeling used published information on the sound source characteristics of vibratory hammering (Illingworth & Rodkin Inc. 2017) that were fed into JASCO's Marine Operations Noise Model (MONM) to model the sound propagation at the two locations and predict SEL and SPL sound fields. Sound fields were modeled using both summer (April–November) and winter (December–March) sound speed profiles, because landfall site cofferdam installation could occur during any month of the year. The modeling study assumed that the installation of each cofferdam would require 10 hours of vibratory hammering per day. The 10 hours per day are assumed to occur continuously or near-continuously, as it is assumed that construction staging will occur in such a manner that sheet piles will be continually provided to the vibratory hammer. It was assumed that the removal of cofferdam sheet piles would require the same amount of time as installation. Table 83 provides the modeled acoustic ranges to the PTS onset (Level A harassment) and behavioral (Level B harassment) sound exposure thresholds for the two landfall sites, and the areas ensonified above these thresholds. Ensonified areas are the area of water ensonified at or above a given acoustic threshold, as defined by the contour of the threshold distance around the modeled sound source, and do not include land (see Figure K-8 of Appendix A).

Level A ranges ($R_{95\%}$) are quite short – a maximum of 372 m (1220 ft) for high-frequency cetaceans in the summer at the MA OECC landfall site. For all other hearing groups, these are substantially smaller. Therefore, Level A take incidental to this activity is unlikely and no Level A take is being requested for cofferdam installation/removal during landfall site construction. On the other hand, take by Level B harassment ($R_{95\%}$) possibly extends to 6.7 km (4.2 mi) for the Connecticut landfall site and out to approximately 8 km (5.0 mi) for the Massachusetts landfall site.

Table 83. Modeled acoustic ranges ($R_{95\%}$) in meters and areas (km^2) ensonified to PTS onset (Level A) and behavioral (Level B) sound exposure thresholds for the different marine mammal hearing groups for vibratory hammering of cofferdams during landfall site construction for the two OECCs using the summer and winter sound speed profiles.

Hearing Group	Level A Threshold[a]	Range (m) to PTS Onset (Level A) Threshold				Area (km^2) Ensonified to Level A Threshold			
		CT OECC		MA OECC		CT OECC		MA OECC	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Low-frequency cetacean	199	54	51	64	61	0.010	0.009	0.015	0.012
Mid-frequency cetacean	198	10	<10	14	10	<0.001	-	<0.001	<0.001
High-frequency cetacean	173	282	180	372	184	0.259	0.109	0.288	0.111
Phocid pinniped in water	201	22	22	28	22	0.002	0.002	0.002	0.002
Hearing Group	**Level B Threshold**	**Range (m) to Behavioral (Level B) Threshold**				**Area (km^2) Ensonified to Level B Threshold**			
		CT OECC		**MA OECC**		**CT OECC**		**MA OECC**	
		Summer	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
All hearing groups	120	4,620	6,710	5,000	7,960	40.6	66.4	29.9	54.4

Summer is April–November and winter is December–March.
CT OECC = Connecticut Offshore Export Cable Corridor, MA OECC = Massachusetts Offshore Export Cable Corridor, PTS = permanent threshold shift.

6.6.3 Exposure and Take Estimates Incidental to Cofferdam Installation/Removal

The ensonified areas (in km^2) from Table 83 were multiplied by the number of animals/km^2 from the Roberts et al. (2016; 2023; 2024) density models (Table 82) to arrive at Level B exposure estimates for one day of vibratory hammering for cofferdam installation/removal at each of the modeled locations, assuming 10 hours of vibratory hammering per day (Table 84). With 10 hours per day of vibratory hammering, each cofferdam would require 10 days for installation and 10 days for removal. However, cofferdam installation and removal could occur during any month of the year and will only be done during daylight hours; in the shortest month of the year, there are only approximately 7 hours of daylight available. Therefore, to estimate takes, it was assumed that each cofferdam would require 14 seven-hour days for installation and 14 seven-hour days for removal. This is a conservative assumption because if cofferdam installation/removal occurs during days with more daylight hours, fewer days will be required to complete installation and removal. To calculate the total take estimates, the greater of the summer and winter estimates was used to provide a maximum density-based exposure estimate for each species and each location. For the Connecticut landfall site, it is assumed that two temporary cofferdams will be required, and the Massachusetts landfall site was assumed to require three temporary cofferdams. Thus, the per day exposure estimates for cofferdam installation or removal shown in Table 84 were multiplied by 28 days (duration of installation and removal each cofferdam) and then by the number of cofferdams at each location (two at the CT OECC and three at the MA OECC) to arrive at maximum total density-based exposure estimates for both installation and removal (Table 85). To ensure sufficient take is requested for this activity, the maximum density-based exposure estimates were compared with PSO data-based estimates and with average animal group size.[12] The largest of these three exposure estimates was used as the take estimate. This comparison and the resulting take estimates for the two OECC landfall sites are provided in Table 85. As shown in Table 85, the resulting Level B take estimates for the two OECC landfall sites are based on PSO data for fin, humpback, minke, and sei whales as well as for bottlenose and common dolphins and long-finned pilot whales. Level B take estimates for the two OECC landfall sites are based on average group size for sperm whales, Atlantic spotted, Atlantic white-sided, and Risso's dolphins, as well as short-finned pilot whales. Level B take estimates for the remaining species are density-based. For NARWs, the density-based and PSO data-based take estimates are the same (n = 2) for the Connecticut OECC landfall site, and the estimate for the Massachusetts OECC landfall site is density-based.

Table 84. Marine mammal Level B exposure estimates for one day of cofferdam installation/removal, assuming 10 hours of vibratory hammering per cofferdam per day, at each OECC landfall site and for each season.

	Level B Exposure Estimate			
	CT OECC		MA OECC	
Species	Summer	Winter	Summer	Winter
Mysticetes (LF hearing group)				
Fin whale*	0.01	0.01	0.01	0.01
Humpback whale	0.02	0.04	0.01	0.02
Minke whale	0.09	0.01	0.06	0.02
North Atlantic right whale*	0.01	0.02	0.02	0.04
Sei whale*	0.01	0.02	0.01	0.02
Odontocetes (MF hearing group)				
Sperm whale*	0.01	0.01	0.01	0.01
Atlantic spotted dolphin	0.01	0.01	0.01	0.01
Atlantic white-sided dolphin	0.20	0.30	0.03	0.04
Common bottlenose dolphin	0.02	0.02	0.05	0.05
Common dolphin	0.59	0.74	0.33	0.51
Pilot whale, long-finned	0.01	0.01	0.01	0.01
Pilot whale, short-finned	0.01	0.01	0.01	0.01
Risso's dolphin	0.01	0.01	0.01	0.01
Odontocetes (HF hearing group)				
Harbor porpoise	0.51	1.30	0.39	1.13
Pinnipeds (PPW hearing group)				
Gray seal	12.51	4.60	8.84	16.97
Harbor seal	2.52	0.93	1.78	3.42

* Indicates species listed as endangered under the US Endangered Species Act.

[12] The Palka et al. (2021) RI/MA Wind Energy Study Area, on which the AMAPPS group sizes are based, includes a 10-km buffer around the RI/MA WEA that extends close to the RI and MA shores (see Palka et al. 2021, Appendix III, Figure 2-1). Similarly, the PSO data are from HRG surveys that include the offshore Lease Area as well as potential OECC routes in both Federal and State nearshore waters of Massachusetts, Rhode Island, Connecticut, New York, and New Jersey (see Figure 1 of Vineyard Northeast 2022). Thus, both group size estimates are averages that include both offshore and nearshore sightings and thus could overestimate group size in areas where group sizes are smaller or underestimate group size in areas where group sizes are larger. However, both estimates are appropriate for the area surrounding the landfall sites, and using the maximum of the two is a conservative assumption.

Table 85. Comparison of density- and PSO-based exposure estimates and average animal group sizes, and the resulting Level B take estimate[c] incidental to cofferdam installation/removal at the two OECC landfall sites.

Species	Maximum Density-based Exposure Estimate		PSO Data-based Estimate[a]		Mean Group Size[b]	Level B Take Estimate	
	CT OECC	MA OECC	CT OECC	MA OECC		CT OECC	MA OECC
Mysticetes (LF hearing group)							
Fin whale*	0.56	0.84	18.87	28.30	2.0	19	29
Humpback whale	2.24	1.68	33.83	50.74	2.2	34	51
Minke whale	5.04	5.04	15.21	22.82	1.4	16	23
North Atlantic right whale*	1.12	3.36	1.95	2.93	2.0	2	4
Sei whale*	1.12	1.68	3.65	5.48	1.7	4	6
Odontocetes (MF hearing group)							
Sperm whale*	0.56	0.84	-	-	2.0	2	2
Atlantic spotted dolphin	0.56	0.84	0.73	1.10	24.0	24	24
Atlantic white-sided dolphin	16.80	3.36	1.98	2.97	19.1	20	20
Common bottlenose dolphin	1.12	4.20	142.45	213.68	13.0	143	214
Common dolphin	41.44	42.84	1194.45	1791.68	24.3	1195	1792
Pilot whale, long-finned	0.56	0.84	16.28	24.43	6.2	17	25
Pilot whale, short-finned	0.56	0.84	-	-	8.0	8	8
Risso's dolphin	0.56	0.84	0.88	1.32	12.0	12	12
Odontocetes (HF hearing group)							
Harbor porpoise	72.80	94.92	-	-	2.5	73	95
Pinnipeds (PPW hearing group)							
Gray seal	700.56	1425.48	9.66	14.50	1.4	701	1426
Harbor seal	141.12	287.28	1.95	2.92	1.4	142	288

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data-based estimate is the daily PSO sighting rate from the last column of Table 9 multiplied by the number of days of vibratory hammering for cofferdam installation/removal in each of the two areas.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in Table 10.
c Level B take estimates for the two OECC landfall sites are based on PSO data for: fin, humpback, minke, and sei whales; bottlenose and common dolphins; and long-finned pilot whales. Level B take estimates for the two OECC landfall sites are based on average group size for: sperm whales; Atlantic spotted, Atlantic white-sided, and Risso's dolphins: and short-finned pilot whales. Level B take estimates for the remaining species are density-based. Note that, for North Atlantic right whales, the density-based and PSO data-based take estimates are the same for the Connecticut OECC landfall site, and the estimate for the Massachusetts OECC landfall site is density-based.

6.6.3.1 Vineyard Northeast Full Buildout

For the full buildout of Vineyard Northeast, temporary cofferdams would be installed at both the Connecticut and Massachusetts landfall sites during year 2 (2029) and removed during Year 3 (2030) under Schedule A. Under Schedule B, cofferdams would be installed during year 1 (2028) and removed during year 2 (2029) at the Connecticut landfall site and would be installed during year 3 (2030) and removed during year 4 (2031) at the Massachusetts landfall site. Table 86 provides maximum take estimates for the two schedules for the full buildout. The Level B take estimates provided in the last two columns of Table 85 for the Connecticut and Massachusetts OECC landfall sites include both installation and removal of cofferdams. Therefore, the yearly take estimates in Table 86 for Schedule A Year 2 and Year 3 are the sum of the Level B take estimates for the two landfall sites (Table 85) divided by two (because they are installed in Year 2 and removed in Year 3). Similarly, the yearly take estimates shown in Table 86 for Schedule B Year 1 and Year 2 are the total estimates for the Connecticut landfall site

(Table 85) divided by two (because they are installed in Year 1 and removed in Year 2), and the yearly take estimates shown in Table 86 for Schedule B Year 3 and Year 4 are the total estimates for the Massachusetts landfall site (Table 85) divided by two (because they are installed in Year 3 and removed in Year 4). Estimates were rounded up to an integer after dividing by two.

Table 86. Level B take estimates incidental to vibratory hammering during cofferdam installation/removal for the full buildout of Vineyard Northeast for the two proposed construction schedules.

	Level B Take Estimate – Full Buildout					
	Schedule A		Schedule B			
Species	Year 2 (2029)	Year 3 (2030)	Year 1 (2028)	Year 2 (2029)	Year 3 (2030)	Year 4 (2031)
Mysticetes (LF hearing group)						
Fin whale*	24	24	10	10	15	15
Humpback whale	43	43	17	17	26	26
Minke whale	20	20	8	8	12	12
North Atlantic right whale*	3	3	1	1	2	2
Sei whale*	5	5	2	2	3	3
Odontocetes (MF hearing group)						
Sperm whale*	2	2	1	1	1	1
Atlantic spotted dolphin	24	24	12	12	12	12
Atlantic white-sided dolphin	20	20	10	10	10	10
Common bottlenose dolphin	179	179	72	72	107	107
Common dolphin	1494	1494	598	598	896	896
Pilot whale, long-finned	21	21	9	9	13	13
Pilot whale, short-finned	8	8	4	4	4	4
Risso's dolphin	12	12	6	6	6	6
Odontocetes (HF hearing group)						
Harbor porpoise	84	84	37	37	48	48
Pinnipeds (PPW hearing group)						
Gray seal	1064	1064	351	351	713	713
Harbor seal	215	215	71	71	144	144

* Indicates species listed as endangered under the US Endangered Species Act.

6.6.3.2 Project 1

Cofferdam installation/removal will occur first at the Connecticut landfall site, and therefore takes associated with this site will be attributed to Project 1. Under Schedule A, installation would occur during year 2 (2029) and removal would occur during year 3 (2030). Under Schedule B, installation would occur during year 1 (2028) and removal would occur during year 2 (2029). Level B take estimates incidental to cofferdam installation/removal for Project 1 are provided in Table 87. The Level B take estimates for the Connecticut landfall site shown in the second to last column of Table 85 include both installation and removal of cofferdams. Therefore, the yearly take estimates in Table 87 for Schedule A Year 2 and Year 3 and for Schedule B Year 1 and Year 2 are the total take estimates from the Connecticut landfall site divided by two (because they are installed in Year 2 and removed in Year 3 under Schedule A or installed in Year 1 and removed in Year 2 under Schedule B). Estimates were rounded up to an integer after dividing by two.

Table 87. Level B take estimates incidental to vibratory hammering during cofferdam installation/removal of Project 1 for the two proposed construction schedules.

	Level B Take Estimate – Project 1			
	Schedule A		Schedule B	
Species	Year 2 (2029)	Year 3 (2030)	Year 1 (2028)	Year 2 (2029)
Mysticetes (LF hearing group)				
Fin whale*	10	10	10	10
Humpback whale	17	17	17	17
Minke whale	8	8	8	8
North Atlantic right whale*	1	1	1	1
Sei whale*	2	2	2	2
Odontocetes (MF hearing group)	0	0	0	0
Sperm whale*	1	1	1	1
Atlantic spotted dolphin	12	12	12	12
Atlantic white-sided dolphin	10	10	10	10
Common bottlenose dolphin	72	72	72	72
Common dolphin	598	598	598	598
Pilot whale, long-finned	9	9	9	9
Pilot whale, short-finned	4	4	4	4
Risso's dolphin	6	6	6	6
Odontocetes (HF hearing group)	0	0	0	0
Harbor porpoise	37	37	37	37
Pinnipeds (PPW hearing group)	0	0	0	0
Gray seal	351	351	351	351
Harbor seal	71	71	71	71

* Indicates species listed as endangered under the US Endangered Species Act.

6.6.3.3 Project 2

Cofferdam installation/removal for the Massachusetts landfall site will occur after landfall construction at the Connecticut landfall site and takes associated with this site will be attributed to Project 2. Under Schedule A, installation would occur during year 2 (2029) and removal would occur during year 3 (2030). Under Schedule B, installation would occur during year 3 (2030) and removal would occur during year 4 (2031). Level B take estimates incidental to cofferdam installation/removal for Project 2 are provided in Table 88. The Level B take estimates for the Massachusetts landfall site shown in the last column of Table 85 include both installation and removal of cofferdams. Therefore, the yearly take estimates in Table 88 for Schedule A Year 2 and Year 3 and for Schedule B Year 3 and Year 4 are the total take estimates from the Connecticut landfall site divided by two (because they are installed in Year 2 and removed in Year 3 under Schedule A or installed in Year 3 and removed in Year 4 under Schedule B). Estimates were rounded up to an integer after dividing by two.

Table 88. Level B take estimates incidental to vibratory hammering during cofferdam installation/removal of Project 2 for the two proposed construction schedules.

	Level B Take Estimate – Project 2			
	Schedule A		Schedule B	
Species	Year 2 (2029)	Year 3 (2030)	Year 3 (2030)	Year 4 (2031)
Mysticetes (LF hearing group)				
Fin whale*	15	15	15	15
Humpback whale	26	26	26	26
Minke whale	12	12	12	12
North Atlantic right whale*	2	2	2	2
Sei whale*	3	3	3	3
Odontocetes (MF hearing group)	0	0	0	0
Sperm whale*	1	1	1	1
Atlantic spotted dolphin	12	12	12	12
Atlantic white-sided dolphin	10	10	10	10
Common bottlenose dolphin	107	107	107	107
Common dolphin	896	896	896	896
Pilot whale, long-finned	13	13	13	13
Pilot whale, short-finned	4	4	4	4
Risso's dolphin	6	6	6	6
Odontocetes (HF hearing group)	0	0	0	0
Harbor porpoise	48	48	48	48
Pinnipeds (PPW hearing group)	0	0	0	0
Gray seal	713	713	713	713
Harbor seal	144	144	144	144

* Indicates species listed as endangered under the US Endangered Species Act.

6.7 Total Requested Take

The following subsections summarize the total requested take from all Vineyard Northeast activities in each of the five years and totaled across all five years covered by the requested ITRs for the full buildout scenario as well as for Project 1 and Project 2 separately. Because of the overlap assumed between Project 1 and Project 2, the sum of the requested take from the two Projects is greater than the requested take for the full buildout. Therefore, the maximum take requested under the ITRs is represented by the full buildout, while the maximum take associated with each specific Project is represented in the applicable Project-specific tables.

As noted in Section 6.2.1, subsequent to the initial submission of this application in May 2024, NMFS developed and published updated criteria for onset of acoustic injury (PTS) and TTS (NMFS 2024g) that include the new nomenclature proposed by Southall et al. (2019). Additionally, some thresholds have been updated in NMFS' Updated Technical Guidance (NMFS 2024g). The updated thresholds and corresponding exposure estimates as well as acoustic and exposure ranges are included in Appendix A, and alternate take estimates and monitoring zones using these updated thresholds are provided in Appendix B.

As described in Section 3.1, Vineyard Northeast is requesting a limited number of Level B take for four species considered to be rare - blue whale, false killer whale, killer whale, and white-beaked dolphin. For blue whale, false killer whale, killer whale, and white-beaked dolphin, the Level B take request is equal to one average group size (as seen in Table 10) for each year that includes either foundation installation and/or UXO detonation activity. Additionally, the Proponent is requesting a limited number of Level B take for the gray whale, which is considered to be extralimital within the Offshore Development Area. The Level B requested take for the gray whale is equal to 1 during each year that includes foundation installation and/or UXO detonation activity.

6.7.1 Vineyard Northeast Full Buildout

The requested take from all planned activities in each of the five years covered by the requested ITRs for the full buildout assuming Schedule A is shown in Table 89, and for Schedule B in Table 90. The total requested take summed across all five years for the full buildout assuming Schedule A is shown in Table 91 and for Schedule B in Table 92. The relatively higher number of takes by Level B harassment shown in Year 4 of Table 89, for all marine mammals, including NARWs, is mainly driven by the modeling assumption that most monopiles would require the use of vibratory setting prior to impact piling during that year, whereas other years assumed zero to only a few monopiles requiring vibratory setting prior to impact piling. (Refer to Table 13 for an overview of the modeling assumptions and Tables 14–19 for the yearly installation schedules for each modeled scenario.) Vibratory hammering is considered a continuous sound source and therefore the applicable threshold (120 dB SPL_{rms}) is lower than that for impact pile driving (160 dB SPL_{rms}), resulting in a larger Level B impact area.

Table 89. Summary of the requested Level A and Level B take from all activities on an annual basis for the full buildout, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	6	0.1	2	70	1.1	23	75	1.4	25	247	4.0	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	11	0.8	2	83	6.1	17	95	8.0	18	160	12.7	0	0	0.0
Minke whale	21,968	0	7	0.0	6	145	0.7	61	185	1.1	70	468	2.4	0	0	0.0
North Atlantic right whale*	340	0	3	1.0	0	14	4.0	0	17	5.0	0	61	17.9	0	0	0.0
Sei whale*	6,292	0	2	0.0	1	13	0.2	2	11	0.2	2	16	0.3	0	0	0.0
Odontocetes (MF hearing group)																
Sperm whale*	5,895	0	2	0.0	1	6	0.1	0	23	0.4	0	71	1.2	0	0	0.0
Atlantic spotted dolphin	31,506	0	18	0.1	1	66	0.2	0	48	0.2	0	208	0.7	0	0	0.0
Atlantic white-sided dolphin	93,233	0	17	0.0	1	57	0.1	0	608	0.7	0	1827	2.0	0	0	0.0
Common bottlenose dolphin	64,587	0	45	0.1	1	242	0.4	0	768	1.2	0	1699	2.6	0	0	0.0
Common dolphin	93,100	0	374	0.4	1	2017	2.2	0	12242	13.1	0	32809	35.2	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	6	0.0	1	34	0.1	0	83	0.2	0	229	0.6	0	0	0.0
Pilot whale, short-finned	18,726	0	6	0.0	1	22	0.1	0	16	0.1	0	20	0.1	0	0	0.0
Risso's dolphin	44,067	0	9	0.0	0	33	0.1	0	90	0.2	0	468	1.1	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	0	36	0.0	20	314	0.4	3	354	0.4	4	950	1.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	75	0.3	13	1600	5.8	1	1123	4.0	1	1181	4.2	0	0	0.0
Harbor seal	61,336	0	16	0.0	3	324	0.5	1	227	0	1	125	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 90. Summary of the requested Level A and Level B take from all activities on an annual basis for the full buildout, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	1	0.2	0	1	0.2	0	2	0.5	0	1	0.2	0	1	0.2
Fin whale*	6,802	2	44	0.7	15	45	0.9	16	59	1.1	16	139	2.3	19	32	0.7
Gray whale	26,960	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Humpback whale	1,396	1	49	3.6	11	52	4.5	12	62	5.3	15	126	10.1	17	48	4.6
Minke whale	21,968	4	87	0.4	41	119	0.7	43	164	0.9	60	394	2.1	73	146	1.0
North Atlantic right whale*	340	0	8	2.4	0	13	3.8	0	16	4.7	0	40	11.8	0	14	4.1
Sei whale*	6,292	1	9	0.2	1	7	0.1	2	8	0.2	2	16	0.3	2	7	0.1
Odontocetes (MF hearing group)																
Sperm whale*	5,895	1	5	0.1	0	16	0.3	1	16	0.3	0	25	0.4	0	18	0.3
Atlantic spotted dolphin	31,506	1	54	0.2	0	54	0.2	1	60	0.2	0	43	0.1	0	60	0.2
Atlantic white-sided dolphin	93,233	1	47	0.1	0	386	0.4	1	377	0.4	0	1301	1.4	0	525	0.6
Common bottlenose dolphin	64,587	1	130	0.2	0	478	0.7	1	483	0.7	0	944	1.5	0	638	1.0
Common dolphin	93,100	1	1078	1.2	0	7024	7.5	1	6944	7.5	0	14646	15.7	0	10091	10.8
False killer whale	1,298	0	8	0.6	0	8	0.6	0	16	1.2	0	8	0.6	0	8	0.6
Killer whale	unknown	0	4	unknown	0	4	unknown	0	8	unknown	0	4	unknown	0	4	unknown
Pilot whale, long-finned	39,215	1	21	0.1	0	53	0.1	1	58	0.1	0	119	0.3	0	64	0.2
Pilot whale, short-finned	18,726	1	18	0.1	0	18	0.1	1	20	0.1	0	12	0.1	0	20	0.1
Risso's dolphin	44,067	0	27	0.1	0	61	0.1	0	63	0.1	0	133	0.3	0	82	0.2
White-beaked dolphin	536,016	0	30	0.0	0	30	0.0	0	60	0.0	0	30	0.0	0	30	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	6	138	0.2	3	229	0.3	17	340	0.4	3	524	0.6	3	266	0.3
Pinnipeds (PPW hearing group)																
Gray seal	27,911	4	576	2.1	1	459	1.6	10	1078	3.9	1	1735	6.2	1	156	0.6
Harbor seal	61,336	1	118	0	1	94	0	3	217	0	1	207	0	1	36	0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 91. Total 5-year requested Level A and Level B take from all activities for the full buildout, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	50	398	6.6
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	37	348	27.6
Minke whale	21,968	137	804	4.3
North Atlantic right whale*	340	0	95	27.9
Sei whale*	6,292	5	41	0.7
Odontocetes (MF hearing group)				
Sperm whale*	5,895	1	101	1.7
Atlantic spotted dolphin	31,506	1	340	1.1
Atlantic white-sided dolphin	93,233	1	2508	2.7
Common bottlenose dolphin	64,587	1	2753	4.3
Common dolphin	93,100	1	47441	51.0
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	351	0.9
Pilot whale, short-finned	18,726	1	64	0.3
Risso's dolphin	44,067	0	600	1.4
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	27	1653	2.0
Pinnipeds (PPW hearing group)				
Gray seal	27,911	15	3978	14.3
Harbor seal	61,336	5	691	1.1

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 92. Total 5-year requested Level A and Level B take from all activities for the full buildout, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	6	1.5
Fin whale*	6,802	68	317	5.7
Gray whale	26,960	0	5	0.0
Humpback whale	1,396	56	336	28.1
Minke whale	21,968	221	909	5.1
North Atlantic right whale*	340	0	91	26.8
Sei whale*	6,292	8	46	0.9
Odontocetes (MF hearing group)				
Sperm whale*	5,895	2	79	1.4
Atlantic spotted dolphin	31,506	2	271	0.9
Atlantic white-sided dolphin	93,233	2	2635	2.8
Common bottlenose dolphin	64,587	2	2673	4.1
Common dolphin	93,100	2	39783	42.7
False killer whale	1,298	0	48	3.7
Killer whale	unknown	0	24	unknown
Pilot whale, long-finned	39,215	2	314	0.8
Pilot whale, short-finned	18,726	2	88	0.5
Risso's dolphin	44,067	0	366	0.8
White-beaked dolphin	536,016	0	180	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	32	1495	1.8
Pinnipeds (PPW hearing group)				
Gray seal	27,911	17	4003	14.4
Harbor seal	61,336	7	671	1

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

The requested take resulting from pile driving during foundation installation is based on the installation schedules provided in Section 6.3 and therefore will vary based on the numbers of piles installed in each month because marine mammal densities vary by month. For example, there are only four piling days in June for the full buildout under Schedule A (Tables 20 and 21) whereas there are 17 piling days in June for the full buildout under Schedule B (Tables 22–25). Therefore, marine mammal species with higher densities in June than in other months, such as humpback, minke, and sei whales and Atlantic white-sided dolphins (see Table 34) will have higher take estimates during that month under Schedule B than under Schedule A, which could result in higher overall take estimates under Schedule B (compare Table 91 with Table 92). Conversely, there are 56 piling days in September for the full buildout under Schedule A (Tables 20 and 21) whereas there are only 31 piling days in September for the full buildout under Schedule B (Tables 22–25). Therefore, marine mammal species with higher densities in September than in other months, such as sperm whales and Atlantic spotted, common, and Risso's dolphins (see Table 34) will have higher take estimates during that month under Schedule A than under Schedule B, which could result in higher overall take estimates under Schedule A. For rare species, the take request is based on animal group size, with one average group size requested during each year that includes foundation installation and/or potential UXO detonation. Because there are four years of piling under Schedule B and only 2 years of piling under Schedule A, the requested take is higher under Schedule B for all rare species. Similarly, because all UXO detonations would occur during a single year under Schedule A and over two years under Schedule B, the requested take for rare species incidental to UXO detonation is higher under Schedule B.

6.7.2 Project 1

The requested take from all planned activities in each of the five years for only Project 1 assuming Schedule A is shown in Table 93, and for Schedule B in Table 94. The total requested take summed across all five years for only Project 1 assuming Schedule A is shown in Table 95 and for Schedule B in Table 96.

Table 93. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 1, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	7	0.1	2	38	0.6	23	61	1.2	2	38	0.6	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	12	0.8	1	38	2.8	17	69	6.2	1	31	2.3	0	0	0.0
Minke whale	21,968	0	8	0.0	4	80	0.4	61	173	1.1	4	69	0.3	0	0	0.0
North Atlantic right whale*	340	0	4	1.0	0	5	1.5	0	15	4.4	0	11	3.1	0	0	0.0
Sei whale*	6,292	0	2	0.0	1	7	0.1	2	8	0.2	1	4	0.1	0	0	0.0
Odontocetes (MF hearing group)																
Sperm whale*	5,895	0	2	0.0	1	3	0.1	0	22	0.4	0	6	0.1	0	0	0.0
Atlantic spotted dolphin	31,506	0	24	0.1	1	36	0.1	0	36	0.1	0	48	0.2	0	0	0.0
Atlantic white-sided dolphin	93,233	0	20	0.0	1	30	0.0	0	598	0.6	0	219	0.2	0	0	0.0
Common bottlenose dolphin	64,587	0	46	0.1	1	86	0.1	0	661	1.0	0	143	0.2	0	0	0.0
Common dolphin	93,100	0	385	0.4	1	705	0.8	0	11346	12.2	0	1934	2.1	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	7	0.0	1	16	0.0	0	71	0.2	0	25	0.1	0	0	0.0
Pilot whale, short-finned	18,726	0	8	0.0	1	12	0.1	0	12	0.1	0	16	0.1	0	0	0.0
Risso's dolphin	44,067	0	12	0.0	0	18	0.0	0	84	0.2	0	33	0.1	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	0	40	0.0	6	102	0.1	3	307	0.4	1	127	0.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	78	0.3	4	501	1.8	1	410	1.5	1	181	0.7	0	0	0.0
Harbor seal	61,336	0	16	0	1	102	0	1	83	0	0	27	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 94. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 1, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0	0	0	0.0
Fin whale*	6,802	2	44	0.7	15	40	0.8	16	56	1.1	0	0	0.0	0	7	0.1
Gray whale	26,960	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0	0	0	0.0
Humpback whale	1,396	1	50	3.6	11	43	3.9	13	52	4.7	0	0	0.0	0	12	0.8
Minke whale	21,968	4	88	0.4	41	113	0.7	50	221	1.2	0	0	0.0	0	8	0.0
North Atlantic right whale*	340	0	9	2.5	0	10	2.9	0	20	5.9	0	0	0.0	0	4	1.0
Sei whale*	6,292	1	9	0.2	1	5	0.1	1	7	0.1	0	0	0.0	0	2	0.0
Odontocetes (MF hearing group)																
Sperm whale*	5,895	1	5	0.1	0	14	0.2	0	16	0.3	0	0	0.0	0	2	0.0
Atlantic spotted dolphin	31,506	1	60	0.2	0	36	0.1	0	24	0.1	0	0	0.0	0	24	0.1
Atlantic white-sided dolphin	93,233	1	50	0.1	0	369	0.4	0	699	0.7	0	0	0.0	0	20	0.0
Common bottlenose dolphin	64,587	1	132	0.2	0	441	0.7	0	492	0.8	0	0	0.0	0	46	0.1
Common dolphin	93,100	1	1089	1.2	0	6715	7.2	0	8062	8.7	0	0	0.0	0	385	0.4
False killer whale	1,298	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0	0	0	0.0
Killer whale	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	unknown	0	0	unknown
Pilot whale, long-finned	39,215	1	23	0.1	0	48	0.1	0	59	0.2	0	0	0.0	0	7	0.0
Pilot whale, short-finned	18,726	1	20	0.1	0	12	0.1	0	8	0.0	0	0	0.0	0	8	0.0
Risso's dolphin	44,067	0	30	0.1	0	52	0.1	0	64	0.1	0	0	0.0	0	12	0.0
White-beaked dolphin	536,016	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0	0	0	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	6	141	0.2	3	199	0.2	3	252	0.3	0	0	0.0	0	40	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	4	579	2.1	1	395	1.4	1	422	1.5	0	0	0.0	0	78	0.3
Harbor seal	61,336	1	118	0	1	80	0	1	30	0	0	0	0.0	0	16	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 95. Total 5-year requested Level A and Level B take from all activities for Project 1, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	27	142	2.5
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	19	149	12.0
Minke whale	21,968	69	329	1.8
North Atlantic right whale*	340	0	34	10.0
Sei whale*	6,292	4	21	0.4
Odontocetes (MF hearing group)				
Sperm whale*	5,895	1	33	0.6
Atlantic spotted dolphin	31,506	1	144	0.5
Atlantic white-sided dolphin	93,233	1	867	0.9
Common bottlenose dolphin	64,587	1	935	1.4
Common dolphin	93,100	1	14368	15.4
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	118	0.3
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	0	147	0.3
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	10	574	0.7
Pinnipeds (PPW hearing group)				
Gray seal	27,911	6	1169	4.2
Harbor seal	61,336	2	228	0.4

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 96. Total 5-year requested Level A and Level B take from all activities for Project 1, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	33	146	2.6
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	25	156	13.0
Minke whale	21,968	95	429	2.4
North Atlantic right whale*	340	0	42	12.4
Sei whale*	6,292	3	23	0.4
Odontocetes (MF hearing group)				
Sperm whale*	5,895	1	37	0.6
Atlantic spotted dolphin	31,506	1	144	0.5
Atlantic white-sided dolphin	93,233	1	1138	1.2
Common bottlenose dolphin	64,587	1	1110	1.7
Common dolphin	93,100	1	16250	17.5
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	136	0.3
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	0	158	0.4
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	12	631	0.7
Pinnipeds (PPW hearing group)				
Gray seal	27,911	6	1473	5.3
Harbor seal	61,336	3	244	0

* Indicates species listed as endangered under the US Endangered Species Act.
[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

6.7.3 Project 2

The requested take from all planned activities in each of the five years for only Project 2 assuming Schedule A is shown in Table 97, and for Schedule B in Table 98. The total requested take summed across all five years for only Project 2 assuming Schedule A is shown in Table 99 and for Schedule B in Table 100.

Table 97. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 2, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	0	0.0	1	34	0.5	1	17	0.3	25	241	3.9	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	0	0.0	1	46	3.4	1	30	2.2	18	149	11.9	0	0	0.0
Minke whale	21,968	0	0	0.0	3	66	0.3	2	18	0.1	70	462	2.4	0	0	0.0
North Atlantic right whale*	340	0	0	0.0	0	10	2.9	0	4	1.2	0	58	17.1	0	0	0.0
Sei whale*	6,292	0	0	0.0	1	7	0.1	1	5	0.1	2	15	0.3	0	0	0.0
Odontocetes (MF hearing group)																
Sperm whale*	5,895	0	0	0.0	1	5	0.1	0	3	0.1	0	70	1.2	0	0	0.0
Atlantic spotted dolphin	31,506	0	0	0.0	1	60	0.2	0	36	0.1	0	196	0.6	0	0	0.0
Atlantic white-sided dolphin	93,233	0	0	0.0	1	50	0.1	0	49	0.1	0	1814	1.9	0	0	0.0
Common bottlenose dolphin	64,587	0	0	0.0	1	160	0.2	0	133	0.2	0	1656	2.6	0	0	0.0
Common dolphin	93,100	0	0	0.0	1	1324	1.4	0	1502	1.6	0	32447	34.9	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	0	0.0	1	27	0.1	0	20	0.0	0	224	0.6	0	0	0.0
Pilot whale, short-finned	18,726	0	0	0.0	1	20	0.1	0	12	0.1	0	16	0.1	0	0	0.0
Risso's dolphin	44,067	0	0	0.0	0	30	0.1	0	18	0.0	0	462	1.0	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	0	0	0.0	14	96	0.1	1	65	0.1	4	917	1.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	0	0.0	9	790	2.9	1	727	2.6	1	1109	4.0	0	0	0.0
Harbor seal	61,336	0	0	0	2	160	0	1	147	0	1	110	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 98. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 2, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2
Fin whale*	6,802	0	0	0.0	0	6	0.1	1	29	0.4	18	143	2.4	19	26	0.7
Gray whale	26,960	0	0	0.0	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Humpback whale	1,396	0	0	0.0	0	10	0.7	1	37	2.7	17	130	10.5	17	37	3.8
Minke whale	21,968	0	0	0.0	0	7	0.0	3	60	0.3	68	417	2.2	73	140	1.0
North Atlantic right whale*	340	0	0	0.0	0	3	0.9	0	7	2.1	0	42	12.4	5	11	4.7
Sei whale*	6,292	0	0	0.0	0	2	0.0	1	5	0.1	2	17	0.3	2	6	0.1
Odontocetes (MF hearing group)																
Sperm whale*	5,895	0	0	0.0	0	2	0.0	1	3	0.1	0	26	0.4	0	17	0.3
Atlantic spotted dolphin	31,506	0	0	0.0	0	24	0.1	1	36	0.1	0	43	0.1	0	48	0.2
Atlantic white-sided dolphin	93,233	0	0	0.0	0	20	0.0	1	30	0.0	0	1365	1.5	0	512	0.5
Common bottlenose dolphin	64,587	0	0	0.0	0	39	0.1	1	121	0.2	0	976	1.5	0	595	0.9
Common dolphin	93,100	0	0	0.0	0	321	0.3	1	1003	1.1	0	15088	16.2	0	9729	10.4
False killer whale	1,298	0	0	0.0	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6
Killer whale	unknown	0	0	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown
Pilot whale, long-finned	39,215	0	0	0.0	0	7	0.0	1	20	0.1	0	123	0.3	0	59	0.2
Pilot whale, short-finned	18,726	0	0	0.0	0	8	0.0	1	12	0.1	0	12	0.1	0	16	0.1
Risso's dolphin	44,067	0	0	0.0	0	12	0.0	0	18	0.0	0	136	0.3	0	76	0.2
White-beaked dolphin	536,016	0	0	0.0	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0
Odontocetes (HF hearing group)																
Harbor porpoise	85,765	0	0	0.0	0	34	0.0	14	183	0.2	3	541	0.6	3	233	0.3
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	0	0.0	0	68	0.2	9	1036	3.7	1	1741	6.2	1	84	0.3
Harbor seal	61,336	0	0	0.0	0	14	0	2	209	0	1	208	0.3	1	21	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 99. Total 5-year requested Level A and Level B take from all activities for Project 2, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	27	291	4.7
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	20	224	17.5
Minke whale	21,968	75	545	2.8
North Atlantic right whale*	340	0	72	21.2
Sei whale*	6,292	4	27	0.5
Odontocetes (MF hearing group)				
Sperm whale*	5,895	1	78	1.3
Atlantic spotted dolphin	31,506	1	292	0.9
Atlantic white-sided dolphin	93,233	1	1913	2.1
Common bottlenose dolphin	64,587	1	1948	3.0
Common dolphin	93,100	1	35272	37.9
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	270	0.7
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	0	510	1.2
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	19	1077	1.3
Pinnipeds (PPW hearing group)				
Gray seal	27,911	11	2625	9.4
Harbor seal	61,336	4	417	0.7

* Indicates species listed as endangered under the US Endangered Species Act.
[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 100. Total 5-year requested Level A and Level B take from all activities for Project 2, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	38	202	3.5
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	35	212	17.7
Minke whale	21,968	144	622	3.5
North Atlantic right whale*	340	5	63	20.0
Sei whale*	6,292	5	30	0.6
Odontocetes (MF hearing group)				
Sperm whale*	5,895	1	48	0.8
Atlantic spotted dolphin	31,506	1	151	0.5
Atlantic white-sided dolphin	93,233	1	1927	2.1
Common bottlenose dolphin	64,587	1	1730	2.7
Common dolphin	93,100	1	26140	28.1
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	208	0.5
Pilot whale, short-finned	18,726	1	48	0.3
Risso’s dolphin	44,067	0	242	0.5
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (HF hearing group)				
Harbor porpoise	85,765	20	990	1.2
Pinnipeds (PPW hearing group)				
Gray seal	27,911	11	2928	10.5
Harbor seal	61,336	4	452	1

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

7 Anticipated Impact of the Activity

The ability to hear and transmit (echolocation and vocalization) sound is vital for marine mammals to perform basic life functions, such as foraging, navigating, communicating, and avoiding predators. Marine mammals use sound to gather and understand information about their environment, including detection of prey, predators, and conspecifics, and phenomena such as wind, waves, and rain, as well as anthropogenic sounds (Richardson et al. 1995). The distances to which a sound travels through the water and remains audible depends on existing environmental conditions and propagation characteristics (e.g., sea floor topography, stratification, and ambient noise levels) and characteristics of the sound such as sound levels and frequency (Richardson et al. 1995). Vineyard Northeast's construction activities may impact marine mammals behaviorally and physiologically from temporary increases in underwater noise during foundation installation, cofferdam installation/removal, HRG surveys, and UXO detonation. The effects of underwater sounds could include one or more of the following: masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment (TTS or PTS), or non-auditory physical or physiological effects (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007). The level of impact on marine mammals will vary depending on the species and its sensitivity to sound, life stage, orientation, and distance from the activity, the intensity and duration of the sound, and environmental conditions affecting sound propagation. Section 7.1 describes these potential effects and summarizes the available science.

7.1 Potential Effects of Vineyard Northeast Activities on Marine Mammals

Vineyard Northeast's construction activities have the potential to take marine mammals by both Level A and Level B harassment. Level A harassment would be limited to hearing impairment, with no lethal or other injurious takes anticipated or requested. Level B harassment could include masking of sounds important to marine mammals – which could impact behaviors that involve communication, such as socializing, foraging, mating, and predator detection – as well as other behavioral disturbance, including avoidance.

Impact pile driving produces regular, pulsed sounds of short duration. These pulsed sounds are typically high energy with fast rise times. Exposure to these sounds may result in Level A or Level B harassment depending on proximity to the sound source and a variety of environmental and biological conditions (Nedwell et al. 2007; Dahl et al. 2015). Sounds generated by vibratory pile setting, vibratory hammering during cofferdam installation/removal, and drilling are considered to be continuous and non-impulsive. Relative to impact pile driving, these sound sources have minor contributions to the cumulative sound exposure levels used to estimate Level A harassment. However, continuous sounds have a greater potential to result in Level B harassment because of the lower sound threshold (SPL_{rms} 120 dB), which results in larger areas ensonified above the threshold level.

Most types of HRG survey equipment produce impulsive sounds that could have similar effects on marine mammals as impact pile driving; however, the sounds produced by HRG survey equipment are typically at higher frequencies, lower source levels, and have a much higher repetition rate than impact pile driving. Despite generating sounds at frequencies below 180 kHz, certain characteristics of the signals produced by some HRG survey instruments mean that they are unlikely to cause takes of marine mammals (categorized as Tier 4 sources in Ruppel et al. (2022)). No Level A take is being requested for this activity.

Underwater detonations create broadband impulsive sounds with high peak pressures and rapid rise times (Richardson et al. 1995). UXOs with more net explosive weight will produce higher peak pressures, which at close ranges have the potential to cause non-auditory injury to marine mammals. However, non-auditory injury (Level A harassment) resulting from UXO detonation is considered unlikely given the thresholds, associated impact zone sizes, and required mitigation, and none is anticipated or proposed for authorization. Behavioral changes incidental to UXO detonation include disturbance to regular migration and movement patterns, feeding, mating, calving/pupping, and resting (von Benda-Beckmann et al. 2015).

The subsections below summarize relevant studies examining the effects of sound on marine mammals related to masking (Section 7.1.1), behavioral disturbance (Section 7.1.2), and hearing impairment (Section 7.1.3).

7.1.1 Masking

Masking is the obscuring of sounds of interest by interfering sounds, generally at similar frequencies. Introduced underwater sound will, through masking, reduce the effective listening area and/or communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal and if the anthropogenic sound is present for a significant fraction of the time (Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Tennessen and Parks 2016; Guan and Miner 2020). Conversely, if little or no overlap occurs between the introduced sound and the frequencies used by the species, communication is not expected to be disrupted. Also, if the introduced sound is present only infrequently, communication is not expected to be disrupted much, if at all. In addition to the frequency and duration of the masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (Madsen et al. 2002; Branstetter et al. 2013a; Branstetter et al. 2013b; Branstetter et al. 2016; Erbe et al. 2016; Sills et al. 2017).

In the event that masking would occur, it could impact biological functions such as communication, navigation, socializing, mating, foraging, and predator detection (Paiva et al. 2015). Although masking effects of pulsed sounds on marine mammal calls and other natural sounds are expected to be limited, there are few specific studies on this related to impact pile driving. Low-frequency cetaceans such as baleen whales are likely to be more susceptible to masking by the low-frequency noise produced by pile driving (Richardson et al. 1995); however, to date, most studies have considered impacts from a different impulsive source, seismic airguns. Sounds from seismic surveys, which are impulsive like impact pile driving sounds, have been estimated to substantially reduce the communication space of baleen whales (Gedamke 2011; Wittekind et al. 2016). Similarly, David (2006) speculated that noise generated by pile driving with a 6 metric ton diesel hammer has the potential to mask bottlenose dolphin vocalizations at 9 kHz within 6.2 to 9.3 mi (10 to 15 km) from the source if the vocalization is strong and up to 24.9 mi (40 km) if the call is weak. The biological repercussions of a loss of listening area or communication space, to the extent that this occurs, are unknown.

Some cetaceans, including baleen whales, continue calling in the presence of impulsive sounds from pile driving (Fernandez-Betelu et al. 2021) and seismic pulses (Greene and Richardson 1988; McDonald et al. 1995; Smultea et al. 2004; Holst et al. 2005; Holst et al. 2006; Dunn and Hernandez 2009; Holst et al. 2011; Nieukirk et al. 2012; Thode et al. 2012; Bröker et al. 2013; Cerchio et al. 2014; Sciacca et al. 2016). Studies on sperm whales found that they continued calling in the presence of seismic pulses (Madsen et al. 2002; Tyack et al. 2003; Smultea et al. 2004; Holst et al. 2006; Jochens et al. 2008;

Holst et al. 2011; Nieukirk et al. 2012). Dolphins and porpoises are also commonly heard calling while airguns are operating (Gordon et al. 2003; Holst et al. 2005; Potter et al. 2007; Holst et al. 2011).

Other cetaceans are known to increase the source level of their calls, shift their peak frequencies, or otherwise modify their vocal behavior (increase or decrease call rates) in response to pulsed sounds from pile driving (Fernandez-Betelu et al. 2021), airguns (Clark and Gagnon 2006; Di Iorio and Clark 2010; Castellote et al. 2012; Blackwell et al. 2013; Blackwell et al. 2015), or vessel noise (e.g., (Richardson et al. 1995; Lesage et al. 1999; Nieukirk et al. 2005; Scheifele et al. 2005; Parks et al. 2007; Hanser et al. 2009; Holst et al. 2009; Parks et al. 2009; Di Iorio and Clark 2010; Parks et al. 2010; McKenna 2011; Castellote et al. 2012; Melcón et al. 2012; Parks et al. 2012; Risch et al. 2012; Tyack and Janik 2013; Luís et al. 2014; Sairanen 2014; Papale et al. 2015; Wang et al. 2015; Dahlheim and Castellote 2016; Gospić and Picciulin 2016; Heiler et al. 2016; Martins et al. 2016; O'Brien et al. 2016; Parks et al. 2016; Bittencourt et al. 2017). Similarly, harbor seals have been shown to increase the minimum frequency and amplitude of their calls in response to vessel noise (Matthews 2017). This behavior could, in turn, minimize potential impacts of masking. However, Holt et al. (2015) reported that changes in vocal modifications can have increased energetic costs for individual marine mammals. It is not known how often these types of vocal responses occur upon exposure to impulsive sounds. If marine mammals exposed to sounds sometimes respond by changing their vocal behavior, this adaptation, along with directional hearing and preadaptation to tolerate some masking by natural sounds (Richardson et al. 1995) would all reduce the importance of masking. Some studies have found evidence of reduced calling (or at least reduced call detection rates) in the presence of seismic pulses. Bowhead whales (*Balaena mysticetus*) in the Beaufort Sea have been observed to decrease their calling rates in response to seismic operations, although movement out of the area also contributes to the lower call detection rate (Blackwell et al. 2013; Blackwell et al. 2015). Among the odontocetes, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles et al. 1994).

Given the higher duty cycle of impact pile driving (one strike every ~two seconds) compared to most airgun surveys (one pulse every ~10 seconds), there may be a somewhat greater potential for masking to occur during pile driving. Compared to the 24 hour per day operation of airguns during most seismic surveys, the total time during which masking might occur in relation to pile driving would be less. Madsen et al. (2006) argued that significant masking effects would be unlikely during impact pile driving given the intermittent nature of these sounds and short signal duration.

The potential for masking from vibratory pile driving (a continuous sound) is expected to be less than that for impulsive sounds (e.g., impact pile driving). A recent study (Matthews et al. 2018) compared potential impacts to marine mammals from two different geophysical survey sources—a non-impulsive source, the marine vibrator (MV), and a strong impulsive source, an airgun array. Potential impacts were assessed by comparing signal level, duration, and bandwidth, which are all parameters known to contribute to masking. The MV array was found to ensonify the marine environment for periods 36–67% longer than the airgun array (Matthews et al. 2018). The longer duration of MV sounds, relative to airgun pulses, increases the potential for MV sound to mask signals of interest to marine mammals. However, despite longer signal durations, MV arrays were found to be less likely than airgun arrays to result in masking for most species because the distances within which MV sounds may be perceived were smaller, and the main frequencies produced by the MV source did not overlap with the hearing ranges of most marine mammals (Matthews et al. 2018). The higher the peak pressure level (SPL_{pk}), cumulative sound exposure level (SEL_{cum}), and sound pressure level (SPL_{rms}) of airgun sounds means that the distances within which masking might occur were two to more than five times greater for the airgun arrays than the

MV arrays (Matthews et al. 2018). Thus, the lower amplitude of non-impulsive MV sounds resulted in smaller ranges of potential masking than those predicted for airgun arrays (Matthews et al. 2018).

Low-frequency cetaceans such as baleen whales are likely to be more susceptible to masking by low-frequency sounds, such as from pile driving and vessels. In contrast, masking effects from those activities are expected to be negligible in the case of smaller odontocetes and pinnipeds, given that sounds important to them occur predominantly at higher frequencies. For example, the harbor porpoise produces echolocation clicks of 110–150 kHz (Møhl and Andersen 1973; Teilmann et al. 2002) with source levels of 135–177 dB re 1 µPa at 1 m and the common bottlenose dolphin produces echolocation clicks of 110–130 kHz with source levels of 218–228 dB re 1 µPa (Richardson et al. 1995).

7.1.2 Behavioral Disturbance

Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Marine mammals’ behavioral responses to sound range from no response to mild aversion, to panic and flight (Southall et al. 2007). Behavioral reactions of marine mammals to sound are difficult to predict in the absence of site- and context-specific data; reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Southall et al. 2007; Ellison et al. 2012; Ellison et al. 2018). Behavioral responses to sound in the marine environment can interfere with the motivation and attention of an animal (Branstetter et al. 2018), can lead to decreased foraging efficiency or displacement from preferred feeding habitats, and can interfere with other biological functions. If a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (Lusseau and Bejder 2007; Weilgart 2007; New et al. 2013; Nowacek et al. 2015; Forney et al. 2017). Wisniewska et al. (2018) suggested that a decrease in foraging success could have long-term fitness consequences. However, (Kastelein et al. 2019b) surmised that if disturbance by noise would displace a marine mammal (e.g., harbor porpoise) from a feeding area or otherwise impair foraging ability for only a short period of time (e.g., 1 day), it would be able to compensate by increasing its food consumption following the disturbance. In some cases, behavioral responses to sound may in turn reduce the overall exposure to that sound (Finneran 2015; Wensveen et al. 2015).

7.1.2.1 Summary of Behavioral Studies Involving Pile Driving Sounds

Most studies specific to behavioral responses of marine mammals to offshore wind developments have been conducted on harbor porpoise (Tougaard et al. 2003; Tougaard et al. 2005; Leopold and Camphuysen 2008; Tougaard et al. 2009a; Tougaard et al. 2009b; Bailey et al. 2010; Thompson et al. 2010; Brandt et al. 2011; Scheidat et al. 2011; Dähne et al. 2013b; Thompson et al. 2013; Dähne et al. 2017; Benhemma-Le Gall et al. 2021), harbor and gray seals (Tougaard et al. 2003; Blackwell et al. 2004; Caltrans 2004; Edrén et al. 2004; Tougaard et al. 2005; Teilmann et al. 2006a; Tougaard et al. 2006b; Leopold and Camphuysen 2008; Tougaard et al. 2009a; Tougaard et al. 2009b; Bailey et al. 2010; Edrén et al. 2010; Thompson et al. 2010; Brandt et al. 2011; Scheidat et al. 2011; Skeate et al. 2012; Dähne et al. 2013b; Thompson et al. 2013; Russell et al. 2016; Dähne et al. 2017; Whyte et al. 2020; Benhemma-Le Gall et al. 2021; Hastie et al. 2021), and dolphins (Würsig and Green 2002; Paiva et al. 2015; Graham et al. 2017; Fernandez-Betelu et al. 2021). These studies showed some avoidance during periods of construction activity, but then continued use of the area after construction activities were completed.

Harbor porpoises are known to be fairly responsive to anthropogenic sounds (Richardson et al. 1995) and often avoid pile driving activities . Bailey et al. (2010) suggested that for harbor porpoise, behavioral disturbance from impact pile driving may occur up to 70 km (43.5 mi) away (based on a threshold of 90 dB_{p-p} re 1 μPa), with major disturbance at distances up to 20 km (12.4 mi) (based on a threshold of 155 dB_{p-p} re 1 μPa). reported avoidance by harbor porpoise of pile-driving activities during construction of an offshore wind farm in the German North Sea. Aerial survey data showed a strong avoidance response within 20 km (12.4 mi) from the activities, whereas static acoustic monitoring showed fewer detections within 10.8 km (6.7 mi) of the sound source, and higher click rates between 25 and 50 km (15.5 and 31.1 mi) from pile driving. Additionally, porpoise click intervals during exposure increased in duration as piling duration increased. Although avoidance by harbor porpoises was also reported during and several hours after pile driving for an offshore wind farm in the German Bight, the avoidance extent was smaller (up to 12 km [7.5 mi]) because bubble curtains (single bubble curtain or two bubble curtains in combination) were used to reduce sound levels by as much as 12 dB (Dähne et al. 2017).

During impact pile driving at Horns Rev I wind farm in the Danish North Sea, harbor porpoise acoustic activity decreased; however, it resumed to baseline levels 3–4.5 hours after the cessation of pile driving activities (Tougaard et al. 2003; Tougaard et al. 2005). Tougaard et al. (2003) reported that effects of pile driving activity on harbor porpoises were documented at distances of 10–15 km (6.2–9.3 mi) from the activity and included a decrease in feeding behaviors and a decline in the number of porpoises in the Horns Rev area during the construction period compared with periods before and after construction. There were fewer circling porpoises during pile driving and significantly more traveling within 15 km (9.3 mi) of the construction site (Tougaard et al. 2005). Based on Tougaard et al. behavioral effects extended as far as 20–25 km (12.4–15.5 mi) from the construction site. There was complete recovery of acoustic activity during the first year of regular operation of the wind farm; the acoustic activity was actually higher during operation than prior to construction (Tougaard et al. 2006b; Tougaard et al. 2008).

In contrast to the "Before After Control Impact" sampling design used during previous studies at Horns Rev wind farm, a gradient sampling design showed that the behavioral responses of harbor porpoises to pile driving were longer than previously reported. Brandt et al. (2011) recorded no porpoise clicks for at least 1 hr at a distance of 2.6 km (1.6 mi) from the construction site at Horns Rev II, with reduced acoustic activity for 24–72 hours. Out to a distance of 4.7 km (2.9 mi), the recovery time was still longer than 16 hours – the time between pile driving events; recovery time decreased with increasing distance from the construction site (Brandt et al. 2011). At a distance of 22 km (13.7 mi), negative effects were no longer detectable; rather, a temporary increase in click activity was apparent, possibly as a result of porpoises leaving the area near the construction site (Brandt et al. 2011).

During pile driving activities (using both vibratory and impact techniques for sheet pile installation around a gravity-based structure) at the Nysted offshore wind farm off the coast of Denmark, a significant decrease in harbor porpoise echolocation activities and presumably abundance was reported within the construction area and in a reference area 10–15 km (6.2–9.3 mi) from the wind farm (Tougaard et al. 2006a; Teilmann et al. 2008). Carstensen et al. (2006) reported a medium-term porpoise response to construction activities in general and a short-term response to ramming/vibration activities. Porpoises appeared to have left the area during piling but returned after several days (Teilmann et al. 2006a). Two years after construction, echolocation activity and presumably porpoise abundance were still significantly reduced in the wind farm but had returned to baseline levels at the reference sites (Teilmann et al. 2006a, 2008).

Teilmann et al. (2006a) speculated as to the cause of the negative effect of construction persisting longer for porpoises at Nysted than at Horns Rev. Porpoises at Horns Rev may have been more tolerant to disturbance, because the area is thought to be important to porpoises as a feeding ground; the Horns Rev area has much higher densities of animals than Nysted (Teilmann et al. 2006a). Another explanation proposed by Teilmann et al. (2006a) took into account that the Nysted wind farm is located in a sheltered area whereas Horns Rev is exposed to wind and waves with higher background noise. Thus, noise from construction may be more audible to porpoises at Nysted than at Horns Rev. Graham et al. (2017) reported that vibratory pile driving had a greater effect on reducing the probability of harbor porpoise occurrence in a construction area than impact pile driving.

Scheidat et al. (2011) suggested that harbor porpoise distribution was fairly quick to recover after construction of the Dutch offshore wind farm Egmond aan Zee because acoustic activity of harbor porpoises was greater during the three years of operation than the two years prior to construction. In addition, Leopold and Camphuysen (2008) noted that construction of the wind farm Egmond aan Zee did not lead to an increase strandings in the area. Harbor porpoises near pile driving activities in Scotland may have exhibited a short-term response within 1–2 km (0.6–1.2 mi) of the installation site, but this lasted no longer than 2–3 days (Thompson et al. 2010). Harbor porpoise occurrence decreased (as indicated by a decline in echolocation clicks) during pile driving activities at Scottish offshore wind farms; displacement was reported to occur at distances of up to 12 km (7.5 mi) from the activities (Benhemma-Le Gall et al. 2021). Changes in buzzing activity relative to pile driving occurred at two wind farm sites, but results were variable (Benhemma-Le Gall et al. 2021).

During the construction of a harbor wall in Demark, which involved pile driving of 175 wooden piles, a 40 m (131 ft)-long bubble curtain was constructed in hopes of reducing noise effects on three harbor porpoises in a facility on the opposite side of the harbor (Lucke et al. 2011). The bubble curtain was found to be helpful in reducing the piling noise, and the initial avoidance behavior of the harbor porpoises to the piling sound was no longer apparent after installation of the bubble curtain (Lucke et al. 2011).

Captive studies of harbor porpoise have shown an increase in swim speeds and a possible decrease in foraging efficiency in captive animals exposed to playbacks of impact pile driving sounds as well as stronger reactions to the higher frequency sounds in pile driving (Kastelein et al. 2018a; Kastelein et al. 2019b; Kastelein et al. 2022). Based on the available literature, avoidance responses by harbor porpoise during Vineyard Northeast pile driving are expected to be relatively minor and temporary, resulting in minimal overall impacts.

There have also been some studies regarding the impact of pile driving on dolphins. Graham et al. (2017) reported that bottlenose dolphins spent less time in a construction area when impact or vibratory piling was occurring. The longer duration of non-impulsive sounds produced by vibratory pile driving may result in greater temporal potential for behavioral disturbance; however, responses are expected to be short-term. In a captive study assessing the effects of playbacks of vibratory piling sound on echolocation and vigilance in bottlenose dolphins, five dolphins were required to scan their enclosure and indicate the occurrences of phantom echoes during five different source levels of vibratory pile driver playback sounds – no-playback control, 100, 120, 130, and 140 dB re 1 µPa (Branstetter et al. 2018). The initial cessation of echolocation activity during the first 140 dB re 1 µPa exposure suggested a shift of attention from the task to the noise source and/or a decrease in motivation to perform the task. The continued performance decrement for the post-exposure condition, in which there was no noise exposure, suggests the animals' motivation state was a major, if not the primary, factor influencing target detection performance and vigilant behavior. Rapid acclimation to the noise exposure was demonstrated by all animals within the study.

(Paiva et al. 2015) reported a significant decrease in the number of Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) detections during pile driving activities, which included vibratory and impact driving. In another study, Indo-Pacific humpback dolphins (*Sousa chinensis*) exposed to $L_{p,rms}$ of 170 dB remained within 300–500 m of the percussive pile driving area before, during, and after operations; although some dolphins temporarily abandoned the work area, their numbers returned close to those seen pre-construction during the follow-up survey seven months after construction activities ended (Würsig and Green 2002). During construction activities at wind farms located 20–75 km (12.4–46.6 mi) from coastal waters where bottlenose dolphins occur in Moray Firth, North Sea, dolphin vocalizations were detected acoustically during pile driving, but a temporary increase in call detections was reported (Fernandez-Betelu et al. 2021).

The effects of pile driving on the distribution and behavior of pinnipeds may be small in comparison to the effects on cetaceans. Ringed seals exposed to pile driving pulses exhibited little or no reaction at a shallow water site in the Alaskan Beaufort Sea; at the closest point (63 m [206.7 ft]), received levels were SPL_{rms} 151 dB re 1 μPa and SEL 145 dB re 1 $\mu Pa^2 \cdot s$ (Blackwell et al. 2004). In contrast, harbor seals may be more responsive to pile driving sound. At the Horns Rev wind farm, no seals were observed during ship-based surveys in the wind farm during pile driving (Tougaard et al. 2006b). However, animals were sighted in the wind farm during other construction activities, although at apparently lower numbers than during baseline conditions (Tougaard et al. 2006b). Bailey et al. (2010) suggested minor disturbance within 14 km (8.7 mi) (based on a threshold of $L_{p,pk\text{-}pk}$ 160 dB re 1 μPa), and major disturbance within 215 m (820.2 ft) (based on a threshold of $L_{p,p\text{-}p}$ 200 dB re 1 μPa) of pile driving activities for harbor and gray seals. Russell et al. (2016) reported displacement of harbor seals during piling when received levels were between $L_{p,pk\text{-}pk}$ 166 and 178 re 1 μPa. Although displaced during active pile driving, harbor seals were then observed to return to a normal distribution (distribution measured during the non-piling scenario) within two hours of cessation of pile driving (Russell et al. (2016). Using data from tagged harbor seals, Whyte et al. (2020) estimated that seal densities would be reduced within 25 km (15.5 mi) or above single strike SELs (averaged across depths and pile installations) of 145 dB re 1 $\mu Pa^2 \cdot s$. Hastie et al. (2021) found that captive gray seals made foraging decisions consistent with a risk versus profit approach, which led to diminished foraging success by seals at low-density prey patches compared with high-density prey patches during exposure to playbacks of pile driving sounds. Based on population modeling and taking into account potential behavioral and auditory effects from pile driving noise from offshore wind farms, Thompson et al. (2013) reported no long-term changes in the viability of the population of harbor seals at Moray Firth.

Remote video monitoring showed that harbor seal haul-out behavior was affected by pile driving at an offshore wind farm (Nysted) in the western Baltic (Edrén et al. 2004; Edrén et al. 2010). The authors found a short-term reduction in the number of seals hauled out at nearby beaches during periods with pile driving versus periods with no pile driving. Sound levels were not measured, and observations of seals in the water were not made. The authors suggest that seals may have spent more time in the water because this is a typical response to disturbance or the seals may have used an alternate haul-out site. However, neither aerial surveys nor remote video monitoring showed a long-term decrease in the number of seals hauled out from baseline conditions to the construction period (Edrén et al. 2004; Thomsen et al. 2006; Edrén et al. 2010). Hauled out harbor seals did not seem to be affected by pile driving noise during construction activities in San Francisco Bay (Caltrans 2004). Similarly, Teilmann et al. (2006b) noted that the reactions of harbor seals to construction activities appeared to be short-term because aerial surveys did not reveal any decrease in overall abundance during the 2002–2003 construction period or 2004–2005 operational period. However, Skeate et al. (2012) suggested a likely link between wind farm construction (e.g., pile driving) and a statistically significant decrease in the number of hauled out harbor seals nearby.

7.1.2.2 Summary of Behavioral Studies Involving Other Impulsive and Intermittent Sounds

Baleen whales generally tend to avoid impulsive sounds from operating airguns, but avoidance radii vary greatly among species, locations, whale activities, oceanographic conditions affecting sound propagation, etc. (Richardson et al. 1995; Gordon et al. 2003). Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to intense sound pulses from airguns often react by moving away from and/or around the sound source. Some of the major studies and reviews on this topic are: Malme et al. (1984); Malme and Miles (1985); Richardson et al. (1986); Ljungblad et al. (1988); Malme et al. (1988); Richardson and Malme (1993); Richardson et al. (1995); McCauley et al. (1998); Miller et al. (1999); Richardson et al. (1999); Gordon et al. (2003); Miller et al. (2005); Stone and Tasker (2006); Johnson et al. (2007); Nowacek et al. (2007); Weir (2008); Moulton and Holst (2010); Stone (2015). Studies of bowhead, humpback, and gray whales have shown that impulsive sounds from seismic airguns with received levels of 160–170 dB re 1 μPa SPL seem to cause obvious avoidance behavior in a substantial portion of the animals exposed (Richardson et al. 1995; 2015). A study conducted across 880,000 km^2 (546,806 mi^2) of the East Atlantic Ocean saw an 88% (82-92%) reduction in sightings of baleen whales and a 53% (41-63%) reduction in toothed whale sightings during active seismic surveys when compared to control surveys (Kavanagh et al. 2019). However, this reflected a redistribution of the animals within the entire study area where overall sighting densities remained unaffected (Kavanagh et al. 2019). Studies near the United Kingdom, Newfoundland and Angola, in the Gulf of Mexico, off Central America, and Alaska have shown localized avoidance of seismic surveys by these species (whales), although dolphins, porpoises, and seals are often seen by observers on active seismic vessels, occasionally at close distances (e.g., bow riding).

While most baleen whales often show only slight overt responses to operating airgun arrays (Stone and Tasker 2006; Weir 2008; Stone 2015; Kavanagh et al. 2019), strong avoidance reactions by several species of baleen whales have been observed. Experiments with a single airgun (327.7–1,638 cubic centimeters [20–100 cubic inches] in size) showed that bowhead, humpback, and gray whales all showed localized avoidance (Malme et al. 1984; Malme and Miles 1985; Malme et al. 1986; Richardson et al. 1986; Malme et al. 1988; McCauley et al. 1998; McCauley et al. 2000; Kavanagh et al. 2019). More recent studies have shown that some species of baleen whale (bowhead and humpback whales in particular) at times show strong avoidance at received levels lower than 160–170 dB re 1 μPa SPL.

When observing migrating bowhead, humpback, and gray whales, the changes in behavior appeared to be of little or no biological consequence to the animals—they simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995; Dunlop et al. 2017). The largest documented avoidance radii involved migrating bowhead whales, which avoided an operating seismic vessel by 12.4–18.6 mi (20–30 km) (Miller et al. 1999; Richardson et al. 1999). In contrast to migrating whales, feeding bowhead whales show much smaller avoidance distances (Miller et al. 2005; Harris et al. 2007), presumably because moving away from a food concentration has greater cost to the whales than does a course deviation during migration.

Groups of humpback whales migrating towards feeding grounds have been observed responding to seismic activity by changing the magnitude and rates of typical behaviors (singing, socializing with conspecifics, using social signals, and migratory travel), specifically through change in movement patterns, dive/respiratory parameters, and rates of breaching (Miller et al. 1999; Richardson et al. 1999; Dunlop et al. 2017; Dunlop et al. 2020). Groups of both humpbacks and female-calf groups exposed to the active seismic array made a 0.6 mi (1 km) per hour slower progression during southern migration compared to most unexposed baseline groups (largely due to divergence off their normal course rather than a slowing down of travel speed) (Dunlop et al. 2017). Similarly, in response to the seismic airgun array, adult pairs reduced their migration speed by 2.5 km (1.55 mi) per hour, which resulted in traveling at a speed of approximately half of their initial travel time (Dunlop et al. 2017). Resting female-calf pairs have been found to show avoidance responses at received levels as low as 129 dB re 1 μPa^2s while migrating humpback whales demonstrated changes in migration at received levels of 144-151 dB re 1 μPa^2s (McCauley 2003; Dunlop et al. 2017).

During a recent study, group vocal periods (GVP) were used as proxies to assess foraging behavior of Cuvier's beaked whales during multibeam mapping in southern California (Varghese et al. 2021). The study found that there was no significant difference between GVP during multibeam mapping and non-exposure periods, suggesting that the level of foraging likely did not change during multibeam mapping. During an analogous study assessing naval sonar (McCarthy et al. 2011), significantly fewer GVPs were recorded during sonar transmission (McCarthy et al. 2011; Varghese et al. 2021). In the fall of 2006, an Ocean Acoustic Waveguide Remote Sensing (OAWRS) experiment was carried out in the Gulf of Maine (Gong et al. 2014); the OAWRS emitted three frequency-modulated (FM) pulses centered at frequencies of 415, 734, and 949 Hz (Risch et al. 2012). Risch et al. (2012) found a reduction in humpback whale song in the Stellwagen Bank National Marine Sanctuary during OAWRS activities that were carried out ~200 km (124 mi) away; received levels in the sanctuary were 88–110 dB re 1 µPa. In contrast, Gong et al. (2014) reported no effect of the OAWRS signals on humpback whale vocalizations in the Gulf of Maine. Range to the source, ambient noise, and/or behavioral state may have differentially influenced the behavioral responses of humpbacks in the two areas (Risch et al. 2014a).

Deng et al. (2014) measured the spectral properties of pulses transmitted by three 200-kHz echosounders and found that they generated weaker sounds at frequencies below the center frequency (90–130 kHz). These sounds are within the hearing range of some marine mammals, and the authors suggested that they could be strong enough to elicit behavioral responses within close proximity to the sources, although they would be well below potentially harmful levels. Hastie et al. (2014) reported behavioral responses by gray seals to echosounders with frequencies of 200 and 375 kHz. Short-finned pilot whales increased their heading variance in response to an EK60 echosounder with a resonant frequency of 38 kHz (Quick et al. 2017), and significantly fewer beaked whale vocalizations were detected while an EK60 echosounder was active vs. passive (Cholewiak et al. 2017).

When comparing the potential for behavioral response to non-impulsive sounds from an MV source versus impulsive sounds from an airgun array using the current NMFS criteria of 120 dB re 1 µPa SPL_{rms} for continuous sounds and 160 dB SPL_{rms} for intermittent sounds (NOAA 2005), models predicted longer distances to the behavioral thresholds for the non-impulsive MV source than the airgun source

(Matthews et al. 2018). The difference in source levels between the two source types (29.5 dB on average) is generally less than the difference between the behavioral thresholds (40 dB). Consequently, longer distances to the behavioral thresholds were found for the MV source than the airgun source, and more animals were predicted to be exposed to sound levels above behavioral thresholds for the MV than the airgun. However, these criteria do not incorporate known differences in the frequency-dependent hearing sensitivity of different marine mammal species or individual variation in the likelihood of behavioral response, nor is there agreement that the 120 dB re 1 μPa is an appropriate threshold for MV sources. When the more realistic, frequency-weighted, multiple-step functions proposed by (Wood et al. 2012) and (DoN 2012) are used for comparative purposes, the result is reversed and fewer animals (by about an order of magnitude) are predicted to be exposed to sound levels above behavioral thresholds for the MV than for airgun arrays. This is primarily caused by the higher source levels (i.e., sound pressure amplitude) of airgun arrays resulting in longer distances to behavioral response thresholds that are nearly equivalent for the two source types using these criteria. However, these results do not directly incorporate context-dependent factors that may affect the likelihood of behavioral response, such as feeding, breeding, or migrating behaviors or the previous exposure history of individuals.

7.1.2.3 Summary

Short-term behavioral reactions in areas where Vineyard Northeast's construction sounds are above disturbance thresholds are expected to have little overall impact on marine mammal species expected to be present within the Offshore Development Area. Overall, odontocete and pinniped reactions to strong impulsive sounds are variable and, at least for delphinids and some porpoises, seem to be confined to a smaller radius than has been observed for some mysticetes. Any displacement would only last for the duration that the sound source is active in that location, with animals resuming regular behavior once the sound source passes. If a marine mammal reacts to an underwater sound by slightly changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (New et al. 2013).

7.1.3 Hearing Impairment

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to intense sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to intense sounds (Southall et al. 2007; Finneran 2015; Kastelein et al. 2018b). There are empirical data on the sound exposures that elicit onset of TTS in captive bottlenose dolphins, belugas, porpoise, and three species of pinnipeds (Finneran 2015). The majority of these data concern non-impulsive sound, but there are some limited published data concerning TTS onset upon exposure to pile driving (Kastelein et al. 2015a; Kastelein et al. 2016), a single pulse of sound from a water gun (Finneran et al. 2002), and multiple pulses from an airgun (Finneran 2015). No TTS was detected when spotted or ringed seals were exposed to impulsive sounds (Reichmuth et al. 2016). A detailed review of TTS data from marine mammals can be found in Southall et al. (2007; 2019). In general, harbor seals and harbor porpoise appear to be more susceptible to TTS than other pinnipeds or cetaceans (Finneran 2015). There have not been any field studies that have examined TTS or permanent hearing damage (i.e., PTS) in free-ranging marine mammals exposed to anthropogenic sounds. However, some studies have shown that bottlenose dolphins can decrease their hearing sensitivity in order to mitigate the impacts of exposure to loud sounds (Nachtigall and Supin 2014; 2015; Nachtigall et al. 2016; 2018; Finneran 2020; Kastelein et al. 2020).

TTS is the mildest form of hearing impairment that can occur during exposure to an intense sound (Kryter 1985). While experiencing TTS, the hearing threshold rises, and a sound must be more intense in order to be heard. It is a temporary phenomenon, and (especially when mild) is not considered to represent physical damage or "injury" (Southall et al. 2007; Le Prell et al. 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. However, research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman et al. 2016). These findings have raised some questions as to whether TTS should continue to be considered a non-injurious effect (Weilgart 2014; Tougaard et al. 2015; 2016; Houser 2021). When PTS occurs, there is physical damage to the sound receptors in the ear, due to neural cell damage and loss of hair cell bodies (Koschinski 2011). In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Physical damage to a mammal's hearing apparatus can occur if it is exposed to sound impulses that have very high peak pressures, especially if they have very short rise times. Rise time is the time interval required for sound pressure to increase from the baseline pressure to peak pressure. Permanent damage can also occur from the accumulation of sound energy over time.

Kastelein et al. (2015b; 2016) reported TTS in the hearing threshold of captive harbor porpoise during playbacks of pile driving sounds. TTS was measured in two captive harbor porpoises after being exposed to recorded impact pile driving sounds with an average received single-strike sound exposure level (SEL_{ss}) of 145 dB re 1 μPa^2s, with exposure duration ranging from 15 minutes to 6 hours (SEL_{cum} ranged from 173 to 187 dB re 1 μPa^2s). Although the pulses had most of their energy in the low frequencies, multiple pulses caused reduced hearing at higher frequencies in the porpoise. It is generally assumed that the effect on hearing is directly related to total received energy; however, this assumption is likely an over-simplification (Finneran 2012). Frequency, duration of the exposure, and occurrence of gaps within the exposure can also influence the auditory effect (Finneran 2012, 2015; Supin et al. 2016; Kastelein et al. 2019a).

Unlike during studies with captive animals, during Vineyard Northeast activities an animal would be able to move away from the sound source, as avoidance behavior has been demonstrated for many marine mammals subjected to loud sounds, thereby reducing the potential for impacts to their hearing ability. There is no specific evidence that exposure to pulses from pile driving or other activities in unrestricted environments is likely to lead to PTS for any marine mammals. Using data from tagged harbor seals, Whyte et al. (2020) estimated that TTS occurrence would be low for free-ranging harbor seals exposed to pile driving sounds. Based on simulation, Schaffeld et al. (2020) reported that TTS in harbor porpoises could only be avoided during multiple exposures to pile driving pulses, if a combination of exclusion zones regulations, previous deterrence by scaring devices, and a soft start were employed as mitigation measures. Similarly, Thompson et al. (2020) recommended a combination of deterrent devices, minimizing hammer energy, and extended soft starts to minimize risks to marine mammals from pile driving. It has been predicted that harbor porpoises and harbor seals could be exposed to TTS without the use of noise mitigation systems (Dähne et al. 2013a; Stöber and Thomsen 2019).

Bailey et al. (2010) measured pile driving sounds during the construction of a wind farm in Scotland and predicted the expected peak broadband sound levels associated with TTS; the peak broadband pressure levels estimated to cause TTS onset in mid-frequency cetaceans (at 224 $dB_{0\text{-}pk}$ re 1 μPa) and pinnipeds (212 $dB_{0\text{-}pk}$ re 1 μPa) would occur within 10 m of pile driving and 40 m, respectively. Through extrapolation of research focused on TTS onset in marine mammals, Bailey et al. (2010) showed that pile driving sounds may cause PTS. Based on regulatory criteria, the peak broadband pressure levels estimated to cause PTS onset in mid-frequency cetaceans (230 dB_{0-pk} re 1 μPa) and pinnipeds (218 dB_{0-pk} re 1 μPa) would occur within 5 m and 20 m, respectively (Bailey et al. 2010). Based on the closest measurement of pile driving noise recorded at 100 m, Bailey et al (2010) indicated that no form of injury or hearing impairment should have occurred at distances greater than 100 m from piling activity.

Although it is unlikely that pile driving activities would cause PTS in many marine mammals, caution is warranted given the limited knowledge about noise-induced hearing damage in marine mammals, the lack of knowledge about TTS and PTS thresholds in many species, and the seemingly greater susceptibility of certain species (e.g., harbor porpoise and harbor seal) to TTS and presumably also PTS. The avoidance reactions of some marine mammals, along with commonly applied monitoring and mitigation measures would reduce the probability of exposure of marine mammals to sounds intense enough to induce PTS.

The criteria used in exposure estimation (Section 6.2) (NMFS 2018) reflect the most recent scientific review and conclusions of NMFS available at the time the modeling was conducted regarding sound levels that could cause PTS.[13] Based on the PTS onset exposure estimates (Sections 6.3.4 and 6.5.3), the number of marine mammals that may experience hearing impairment is quite small, even when planned mitigation measures are not considered. Taking into account that extensive monitoring and mitigation measures will be applied (Section 11), the likelihood of Vineyard Northeast causing PTS in a marine mammal is negligible.

7.2 Population Level Effects

NMFS provides best available estimates of abundance (N_{best}) for all marine mammal stocks under their jurisdiction in their annual Stock Assessment Reports (NMFS 2024a). In some cases, NMFS considers these to be underestimates because the full known range of the stock was not surveyed, the estimate did not include availability-bias correction for submerged animals, or there may be uncertainty regarding population structure (Hayes et al. 2017). The requested take numbers provided in Section 6.7 are shown as a percentage of the NMFS stock abundance estimates in order to assess population level effects. However, the Duke/MGEL Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016; 2023; 2024) also provide abundance estimates for each of their species models available through their web-based Mapper tool, which can be accessed at https://seamap.env.duke.edu/models/Duke/EC/. For some species, these estimates differ considerably from the NMFS stock abundance estimate and it is appropriate to consider these estimates as well, when considering population level effects, because the take estimates are based on the animal densities estimated from these models. Additionally, Level B take estimates also consider PSO sightings-based estimates, which make them applicable to the specific area of impact, and using the maximum of the modeled exposure estimate, PSO data-based estimate, and average group size adds a level of conservatism to the take estimates.

[13] As noted in Section 6.2.1, NMFS has developed and published draft updated criteria for onset of acoustic injury [NMFS] National Marine Fisheries Service. 2024g. 2024 update to: technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (version 3.0). Underwater and in-air criteria for onset of auditory injury and temporary threshold shifts. SIlver Spring, MD. NOAA Technical Memorandum NMFS-OPR-71. Office of Protected Resources,. Available online at https://www.fisheries.noaa.gov/s3/2024-10/Tech-Memo-Guidance-3.0-OCT2024-508-OPR1.pdf. Accessed 24 Oct 2024.; exposure and take estimates using these updated thresholds will be provided in Appendix B.

As seen in Section 6.7 above, for most species, the requested yearly take amounts to only a few percent of the species' NMFS stock size. For the small NARW stock, the maximum yearly requested take is 17.8% of stock abundance, in year 4 for the full buildout under Schedule A, and only Level B take is requested for this species. For all other years under Schedule A, the requested NARW take is <5%. Under Schedule B, the maximum yearly requested NARW take for the full buildout is 11.8% in year 5 and for other years it is <5%. The highest yearly requested take is for common dolphins, with a take request of 35.2% of stock abundance in year 4 for the full buildout under Schedule A. This is based on the 2023 draft Stock Assessment Report (NMFS 2024a) wherein the stock abundance of this species was reduced to 93,100 from the previous estimate of 172,947. However, because the take request is based on the latest Duke/MGEL density model for this species (version 5.1, May 27, 2023, https://seamap.env.duke.edu/models/mapper/EC?species=Short-beaked%20common%20dolphin), it is appropriate to consider the abundance estimates predicted by that model. Monthly abundance estimates for this species from the Duke/MGEL density model are in the range of 121,405–177,543 during the June–November pile driving period, with an average of 151,585 during this period. Thus, the requested take of common dolphins for year 4 under Schedule A as a percentage of the Duke/MGEL average abundance would be only 21.6%.

Overall, the estimated takes expressed as percentages of species populations indicate very low potential for population level impacts. The take estimates are conservative in that they assume no mitigation measures other than 10 dB sound attenuation. The additional mitigation measures, including clearance and shutdown zones as well as soft-starts, when implemented in practice will reduce the estimated take. Thus, the actual take as a percentage of stock size is likely to be lower, and population-level effects are unlikely.

Finally, any effects to marine mammal habitat, including effects to marine mammal prey, are unlikely to result in population-level effects. This is discussed in detail in Section 9 and Section 10 below.

8 Anticipated Impacts on Subsistence Uses

NOAA Office of Protected Resources defines "subsistence" as the use of marine mammals taken by Alaskan Natives for food, clothing, shelter, heating, transportation, and other uses necessary to maintain the life of the taker or those who depend upon the taker to provide them with such subsistence. Vineyard Northeast is located off the Northeast coast of the United States in the Atlantic Ocean. There are no traditional subsistence hunting areas in the region and thus no subsistence uses of marine mammals may be impacted by this action.

9 Anticipated Impacts on Habitat

This section addresses the potential loss or modification of marine mammal habitat resulting from Vineyard Northeast's construction and operation activities and the likelihood of restoration of that habitat. For clarity, potential impacts have been categorized as short-term or long-term in the following subsections. Short-term impacts are those that might occur from the actual construction activities but largely resolve once construction is completed. These include sound introduced into the environment and seafloor disturbance resulting from cable-laying activities, seabed preparation, and vessel anchoring. Long-term impacts are those that persist after construction is completed, including during the operations phase. These include physical alteration of habitat through creation of hard substrate around foundations and loss of habitat from the footprint of the foundations and the structures within the water column.

Structures within the water column alter the local physical oceanography by creating turbulence in the water column around and downstream of the structure. Physical oceanography also can be altered by the extraction of wind energy by the WTG, which can reduce wind speeds downstream of the WTG and impact ocean circulation that is driven by surface winds. Additionally, power transfer through offshore export, inter-array, and inter-link cables generates magnetic fields in the near vicinity of the cables that are likely detectable to marine mammals and their magnetosensitive prey.

9.1 Short-Term Impacts

A variety of impact producing factors (i.e., seafloor disturbance, turbidity, vessel discharges, and construction sounds) with the potential to temporarily affect marine mammal habitat, including prey availability, may be expected as a result of the proposed activities.

9.1.1 Effects of Sound on Marine Mammal Prey

The marine mammal species found within the Offshore Development Area feed on various pelagic and benthic fish species, cephalopods, and crustaceans. Elevated noise levels, installation of structures that disturb the seafloor, and other factors associated with Vineyard Northeast vessels and equipment may cause some prey species to leave the immediate area of activities, temporarily reducing the availability of prey within the area and thus disrupting feeding behavior and efficiency. Displaced prey species are expected to return shortly after construction is completed. Although pathological or physiological effects are also possible (Hawkins and Popper 2017; Weilgart 2017), the number of prey items affected would be a very small percentage of the stocks available in the region.

The most common behavioral responses by fish to anthropogenic noise are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al. 2002; Handegard and Tjøstheim 2005; Sarà et al. 2007; Becker et al. 2013). Increased sound levels from the construction activities and during underwater explosions have the potential to affect local prey populations, which might indirectly affect marine mammals by altering prey abundance, behavior, and distribution (McCauley 2003; Popper and Hastings 2009; Slabbekoom et al. 2010; Danil and St. Leger 2011; von Benda-Beckmann et al. 2015). Marine fish are typically sensitive to noise in the 100 to 500 Hz range, which coincides with the primary frequency range of vessels and pile driving activities. Fish can be reasonably expected to be exposed to similar sounds given the existing ambient noise levels associated with vessel traffic in the region. Noise generated by both impact and vibratory pile driving, as well as other Vineyard Northeast activities, have the potential to elicit behavioral responses in fish, and impact pile driving and UXO detonation also have the potential to cause injury or even mortality as a result of the high peak pressure levels near the source (Yelverton et al. 1975; Hastings and Popper 2005).

Harding et al. (2016) performed laboratory-based experiments on Atlantic salmon exposed to underwater playback of pile driving noise at SPLs of 149.4-153.7 dB re 1µPa; the results showed that there were no observed differences in salmon behavior when exposed to piling noise. Juvenile coho salmon displayed no avoidance behavior from exposure to a real impact-piling event when positioned in cages that were close to the noise source (Ruggerone et al. 2008). However, other studies have shown behavioral responses to impulsive pile driving sounds by European seabass (*Dicentrarchus labrax*), including increased startle responses, swimming speeds, diving behaviors, and school cohesion (Neo et al. 2014), increased opercula beat rates (a sign of stress), increased energy expenditure on alert and defensive behaviors (e.g., inspection of the experimental area), and decreased inspection of possible predators

(Spiga et al. 2017). Both studies showed similar behavioral effects when fish were exposed to continuous drilling sounds, but behavioral recovery times were significantly slower for the impulsive sounds than for the continuous sounds (Neo et al. 2014; Spiga et al. 2017).

Laboratory pile driving studies demonstrated swim bladder damage in Chinook salmon and documented tissue damage in other species (Halvorsen et al. 2012). A similar study saw ruptured swim bladders and/or kidney hemorrhaging in fish that had been exposed to ~96 pile strikes with a sound exposure level (SEL_{ss}) of 183 dB (Casper et al. 2017). Casper et al. (2017) found that physical injuries sustained by the fish increased in both severity and number as the cumulative sound exposure level (SEL_{cum}) increased with higher per-strike energy and total number of strikes. (Hart-Crowser and Illingworth and Rodkin 2009) and (Houghton et al. 2010) exposed caged juvenile coho salmon (*Oncorhynchus kisutch*) to sounds from vibratory pile driving with maximum peak SPLs of 177 to 195 dB re 1 μPa and SELs of 174.8 to 190.6 dB re 1 μPa. They reported no mortalities or behavioral abnormalities; pile driving did not affect the feeding ability of the juvenile coho salmon.

Squid are an extremely important food chain component for many higher order marine predators, and while limited information is available for noise impacts on invertebrate species, squid are known to be able to detect particle motion. Jones et al. (2020) reported alarm responses of squid in response to playbacks of pile driving noise in a laboratory setting, but there appeared to be some rapid, short-term habituation; however, similar startle responses were noted when squid were exposed again 24 hours later. Crustaceans also have shown behavioral responses to pile driving (Tidau and Briffa 2016).

9.1.2 Short-Term Seafloor Disturbance

Short-term seafloor disturbance is expected during seabed preparation prior to the installation of foundations; from offshore cable installation, pre-lay grapnel runs, sand bedform leveling, and boulder clearance (as needed); and as a result of construction vessel anchoring and installation vessel jack-up legs. The maximum expected area of short-term seafloor disturbance is 8.56 km^2 (3.31 mi^2) in the Lease Area, 4.29 km^2 (1.66 mi^2) in the Massachusetts OECC, and 4.05 km^2 (1.56 mi^2) in the Connecticut OECC. This disturbance is expected to largely resolve once construction is completed.

Turbidity resulting from suspension of disturbed sediments is expected to be localized and resolve quickly, without adverse impacts to marine mammal habitat. Potential discharges from vessels and other construction equipment will be localized near their source and are not expected to adversely affect prey species or habitat.

9.2 Long-Term Impacts

Long-term seafloor disturbance will result from the footprint of the foundations and the placement of scour protection around the bases of the foundations as well as from the installation of cable protection for the offshore cables. The maximum expected area of long-term seafloor disturbance for Vineyard Northeast is 2.05 km^2 (0.79 mi^2) in the Lease Area, 0.80 km^2 (0.31 mi^2) in the Massachusetts OECC, and 0.43 km^2 (0.17 mi^2) in the Connecticut OECC. These structures will remain in place for the lifetime of Vineyard Northeast. For Vineyard Northeast, WTGs and ESPs will be oriented in an east-west, north-south grid pattern with 1.85 km (1 NM) spacing between WTG/ESP positions. This layout orientation is consistent throughout the MA and RI/MA Wind Energy Areas. Such large distances between individual foundations will minimize the extent of marine mammals being prevented from use of natural habitat, including migration and feeding.

9.2.1 Physical Oceanographic Effects

The presence of WTG and ESP foundation structures in the water column will create turbulence in the water around and downstream of the foundations. Once operational, wind energy extraction by the WTGs could also reduce wind speeds downstream of the WTGs and affect local ocean circulation that relies on surface winds. These effects, which can influence upwelling, downwelling, stratification, mixing, and circulation, will persist for the operational life of Vineyard Northeast. Concern has been expressed over how these physical oceanographic effects of wind farms might impact the oceanographic processes that drive North Atlantic right whale prey distribution in the Nantucket Shoals region (e.g., Hayes 2022). To address these concerns and inform future environmental assessments, BOEM sponsored the National Academy of Sciences, Engineering, and Medicine (NASEM) to evaluate the best available science and produce a consensus report, resulting in the 2024 publication *Potential Hydrodynamic Impacts of Offshore Wind Energy on Nantucket Shoals Regional Ecology: An Evaluation from Wind to Whales* (NASEM 2024).

The NASEM report points out that major oceanographic changes have occurred in the Nantucket Shoals region beginning in 2000. These include surface and bottom temperature increases, increased frequency of Gulf Stream warm core rings, and midwater intrusions into the tidally mixing inshore region. Additionally, the NASEM report summarizes the shift in NARW distribution beginning in about 2010 from known habitat in the Gulf of Maine, Bay of Fundy, and the Scotian Shelf to the southern Gulf of St. Lawrence and historic whaling grounds south of Cape Cod based on rapid warming and substantial declines in NARW prey (particularly the late-stage of the copepod *Calanus finmarchicus*) in the former habitats (NASEM 2024). It is noteworthy that these major marine ecosystem and physical oceanographic regime shifts are already occurring and had begun well before any wind farm installation in the region. Importantly, the NASEM report points out the varying temporal scales (from hours to decades) and varying spatial scales (from millimeters to ocean basins) of the mechanisms that supply, transport, and aggregate right whale prey into suitable foraging habitat as well as a gap in the basic understanding of which zooplankton taxa NARWs are feeding on and how this changes seasonally in the Nantucket Shoals region (NASEM 2024).

Further, many physical and biological processes are influenced by cross-scale phenomena, necessitating modeling programs that couple physics with zooplankton biology and behavior to better understand the processes of prey patch formation. The lack of available coupled physical–biological models that can effectively consider zooplankton supply and behavior along with the physical oceanographic processes that aggregate zooplankton in the Nantucket Shoals region will make it difficult to predict any impacts of wind farms on right whales (NASEM 2024).

Ocean scientists at Rutgers University Center for Ocean Observing Leadership and the Woods Hole Oceanographic Institution similarly note that the ocean characteristics within the Lease Area and surrounding waters undergo remarkable variability across time scales from days to weeks, seasons, years, and decades that must be considered when assessing potential impacts of wind farms (Kohut et al. 2024). They also point out the significance of seasonality in the oceanographic features important to species in the Nantucket Shoals, and that therefore climate change considerations, including long-term trends in the timing of seasonal stratification setup and breakdown as well as changes in water temperature and storm frequency and intensity that impact stratification and can lead to climate scale shifts in the timing of cold pool formation, duration, and breakdown, must also be considered in assessing any potential impacts.

Given the limited understanding of potential hydrodynamic effects at the level of a single WTG, a single wind farm, or multiple adjacent wind farms, and a lack of region-specific studies on potential impacts, physical oceanographic effects related to WTG and ESP structures will be difficult to isolate from the much larger magnitude of variability introduced by natural and other anthropogenic sources (including climate change) in the dynamic and evolving oceanographic and ecological system of the Nantucket Shoals region (NASEM 2024).

9.2.2 Electromagnetic Fields (EMFs)

Once operational, power transfer through offshore export, inter-array, and inter-link cables will generate EMFs in the near vicinity of the cables that will persist through the operational life of the project. EMFs consist of two components: electric fields and magnetic fields (MFs). The electric fields produced by the voltage on the offshore export cables will be contained by the metallic sheathing and/or steel armoring of the cables; therefore, electric fields are not expected in the marine environment from Vineyard Northeast cables. Magnetic fields are not completely shielded by either metallic sheathing or steel armoring. Accordingly, the Proponent conducted a modeling analysis of the MF levels associated with high-voltage direct current (HVDC) and high-voltage alternating current (HVAC) offshore export cables under consideration for use in the Vineyard Northeast OECCs (Vineyard Northeast 2024b). The modeling analysis, which is excerpted here, examined the offshore export cables that will carry electricity from the ESP(s) to the landfall site(s), given that they are expected to be the largest MF source to the marine environment. The WTGs, as well as the transformers and other power equipment on the ESP(s) and booster station, are not expected to be significant sources of potential MF exposure to marine organisms, given their locations far above the ocean surface (CSA Ocean Sciences Inc. and Exponent 2019). MF levels for the lower voltage inter-array cables that will carry electricity generated by WTGs to the ESP(s) and the inter-link cables that may be used to connect the ESPs together are expected to be lower than those associated with the high voltage offshore export cables, due to lesser current flows, lower voltages, and smaller diameter cables.

As discussed in CSA Ocean Sciences Inc. and Exponent (2019), due to their time-varying nature, the MFs associated with submarine 60-Hz AC cables can induce weak electric fields in the immediate marine environment above the cables. The steady MFs associated with direct current (DC) submarine cables do not induce electric fields, but similar to the induced electric fields associated with water movement and marine animal movement through the earth's geomagnetic field, very weak DC electric fields will be induced by water flow or marine animal movement through the DC MFs associated with DC submarine cables.

For both the HVDC and HVAC offshore export cables, the modeling analyses predicted the highest MF levels directly above the cables, with a rapid fall-off of MF levels with increased lateral distance from the HVDC cable bundles or HVAC cables (Vineyard Northeast 2024b). For the HVDC cable bundles, there was little difference in MF levels from the buried and surface-laid cables at a lateral distance of 7.6 m (25 ft) from either side of the cable bundle centerlines. For the HVAC cables, the modeling analysis showed >95 to >99% reductions in levels of 60-Hz AC MFs at lateral distances of ±7.6 m (±25 ft) from the cable centerlines. MF levels in the water column will be less than the model-predicted MF levels at the seabed or above the cable protection, with the rate of decrease in MF levels as a function of height above the cable bundles/cables being similar to the rate of fall-off as a function of distance laterally from the cable bundles/cables. Overall, the MF modeling analysis provides evidence of highly localized increases in either DC or 60-Hz AC MF levels directly above the cable bundles/cables at the seabed, which fall off rapidly both laterally and vertically moving away from the cable bundles/cables.

No regulatory thresholds or guidelines for allowable EMF levels in marine environments have been established for either HVDC or HVAC submarine power transmission. For HVAC transmission, the weight of the evidence indicates that 60-Hz AC EMFs are above the typical frequency range of EMFs to which magnetosensitive and electrosensitive marine species are known to detect and respond. In particular, magnetosensitive marine species, including marine mammals, are specifically tuned to the earth's steady (DC) geomagnetic field for navigation/migration purposes, while electrosensitive marine species such as sharks and rays respond to electric field frequencies below 10 Hz for helping to locate prey and/or mates (CSA Ocean Sciences Inc. and Exponent 2019). For HVDC transmission, there is a growing body of evidence suggesting that the steady MFs from HVDC cables may be perceptible to some EM-sensitive marine species that are known to detect the earth's steady (DC) geomagnetic field, but there remains a lack of evidence indicating potential harmful impacts at the population- or community-level for the various types of marine species which may experience brief exposure to DC MFs nearby offshore export cables (Taormina et al. 2018; CSA Ocean Sciences Inc. and Exponent 2019; Gill and Desender 2020; NYSERDA 2021; SEER 2022).

10 Anticipated Effects of Habitat Impacts on Marine Mammals

The loss or modification of marine mammal habitat could arise from the introduction of noise, alteration of benthic habitats, and physical presence of vessels and equipment as described in Section 9. These impacts could be short- or long-term in nature. The anticipated effects on marine mammals resulting from impacts to their habitat are summarized below.

10.1 Short-Term Impacts

Disturbances associated with noise produced by construction activities are expected to be short-term and temporary with minor impacts to marine mammal prey species. Noise and its associated disturbance to marine mammal prey resulting from construction activities will only be present during the construction phase. Similarly, seafloor disturbance, resulting suspension of disturbed sediments, and vessel discharges are expected to be localized and temporary. Any short-term impacts to marine mammal prey are expected to largely resolve once construction is completed.

10.2 Long-Term Impacts

Long-term habitat alterations resulting from Vineyard Northeast's activities include the creation of hard substrate around foundations from the installation of scour protection and along portions of the offshore cables from the installation of cable protection, loss of habitat from the footprint of the foundations, and the introduction of structures into the water column. These are intended to remain in place throughout the life of Vineyard Northeast. As noted in Section 9.2, overall habitat alteration due to the footprint of the foundations and scour and cable protection is small (3.28 km^2 [1.27 mi^2]). Further, there is abundant similar habitat in adjacent areas that is available to marine mammals and their prey.

Pinnipeds and some odontocete species are likely to benefit the most from increases in the availability of prey species that are attracted to the physical structures. Numerous surveys at offshore wind farms, oil and gas platforms off California and in the Gulf of Mexico (Claisse et al. 2014; Ajemian et al. 2015; Love et al. 2015), and artificial reef sites have documented increased abundance of smaller odontocete and pinniped species attracted to the increase in pelagic fish and benthic prey availability (Petersen and Malm 2006; Wilhelmsson et al. 2006; Inger et al. 2009; Hammar et al. 2010; Lindeboom et al. 2011; Scheidat et al. 2011; Mikkelsen et al. 2013; Bailey et al. 2014; Russell et al. 2014; Arnould et al. 2015). Fujii (2015, 2016) observed that feeding habits of major fish species were closely associated with an offshore oil platform in the North Sea. Increased prey is not limited to fish aggregation and production. Additionally, offshore platforms may generate sufficient illumination to affect the local distribution of phototaxic prey invertebrates, including zooplankton (Keenan et al. 2007; McConnell et al. 2010; Fujii 2015, 2016). Bergström et al. (2014) summarized probable impacts of wind energy project construction and operation on marine mammals, fish, and benthos, and concluded that there is a moderate level of certainty of significant positive habitat gain for fish arising from wind energy project habitat modification. Other studies suggest that there are little to no differences in species' presence inside and outside wind farms post-construction and during operation (Tougaard et al. 2006b).

Studies examining harbor seal distribution around wind farms have shown seal numbers inside the wind farm to be recovered following construction; however, fewer seals were present on the nearby land sites (Snyder and Kaiser 2009; Vallejo et al. 2017). Harbor porpoise activity around the Danish wind farm "Nysted" showed a significant decline in echolocation activity following construction that gradually increased but did not return to baseline levels (Hammar et al. 2010; Teilmann and Carstensen 2012), while no change in activity was observed around the Danish wind farm "Rodsand II" after construction (Hammar et al. 2010). Russell et al. (2014) conducted a tagging study of harbor and gray seals living near two active wind energy project areas on the British and Dutch coasts of the North Sea. The tag data strongly suggested that the associated wind energy structures were used for foraging, and the directed movements showed that animals could effectively navigate to and between structures (Russell et al. 2014). Studies of harbor porpoise activity within operational wind farms showed that relatively more porpoises were found in the wind farm area than in reference sites, with a statistically positive linkage to the wind energy project (Todd et al. 2007). In a study of the construction of eight offshore wind farms within the German North Sea (Brandt et al. 2016), there were short-term (1 to 2 days) decreases in harbor porpoise detections during piling activities; however, there was no indication of a long-term shift in harbor porpoise distribution attributed to wind farm construction over the 5-year period of the study (i.e., harbor porpoises had repopulated the wind farms). Similarly, projects to restore artificial reefs noted an increase in the presence of harbor porpoises at the new artificial reef site compared to surrounding habitats, and it was hypothesized they were following prey species (Mikkelsen et al. 2013). Thus, although studies on the long-term impacts of wind farms on marine mammals are limited, there is evidence that, at least in some cases, there is suitable habitat, including prey, within wind farm waters.

A negative effect of habitat gain may emerge if the infrastructure functions as habitat where invasive species can establish (Bulleri and Airoldi 2005; Page et al. 2006). The opportunistic use of artificial substrata (oil and gas platforms) by non-indigenous coral species in the Gulf of Mexico is well documented, with growing concern related to a spread of these species to the Atlantic as marine infrastructure increases (Sammarco et al. 2010). Over the lifetime of Vineyard Northeast's operation, more structurally complex habitats that might develop in artificial infrastructure are likely to have greater species diversity and abundance.

Currently there are no quantitative data on how large whale species (i.e., mysticetes) may be impacted by offshore wind farms (Kraus et al. 2019). For Vineyard Northeast, WTGs and ESPs will be oriented in an east-west, north-south grid pattern with 1.85 km (1 NM) spacing between WTG/ESP positions. This layout orientation is consistent throughout the MA and RI/MA Wind Energy Areas. Such large distances between individual foundations is not expected to impede navigation through the Lease Area. Additionally, there is no evidence of large-scale avoidance by right whales of recently installed windfarms in the Nantucket Shoals region as evidenced by sightings and acoustic detections in this region using the WhaleMap interactive online tool (Johnson et al. 2021), available at https://whalemap.org/WhaleMap/.

It is unknown how wakes in water currents created by the presence of the foundations or potential decreases in surface winds from wind energy extraction by the operational WTGs could affect marine mammal prey. There is no evidence to suggest that population-level effects to pelagic fish, plankton, or benthic species are likely, so marine mammals foraging on these species are unlikely to be adversely affected. Knowledge of the effects of offshore WTGs on the local physical oceanography is primarily based on modeling studies in the North Sea that have not been validated by observations, where conditions differ from those in the Nantucket Shoals region. Given this limited understanding and lack of region-specific studies, physical oceanographic effects related to WTG and ESP structures are difficult to predict and/or detect (NASEM 2024).

Given the lack of robust coupled physical and biological models that are able to effectively incorporate the supply of zooplankton, their behavior, and the physical oceanographic processes that aggregate zooplankton in the Nantucket Shoals region in sufficient densities for right whale foraging, it is difficult to predict potential impacts of wind farms on right whales. There exist potential hydrodynamic mechanisms that support either an increase or a decrease in zooplankton productivity and/or aggregation as well as no appreciable impact on right whale prey availability and foraging dynamics (NASEM 2024). Moreover, the impacts of any physical oceanographic changes from offshore wind development in the Nantucket Shoals region on zooplankton will be difficult to isolate from the much larger magnitude of variability introduced by natural and other anthropogenic sources (including climate change) in this dynamic and evolving oceanographic and ecological system (NASEM 2024).

The impacts of MFs induced by power flow through the offshore export, inter-array, and inter-link cables are likely to be minimal, based on their localized nature (within 7.6 m [25 ft] of the cable centerlines for offshore export cables) as well as the lack of reported evidence of significant harms to EMF-sensitive marine species from either HVDC or HVAC submarine transmission. Species that feed near the benthos have been observed to be at greater risk to behavioral disturbance due to EMF exposure than those that feed in the water column (Normandeau Associates et al. 2011). Species likely to occur within the Offshore Development Area are not benthic foragers. Because they breathe at the sea surface and have large migratory ranges, marine mammals would not be expected to spend significant amounts of time near the seafloor in the vicinity of specific submarine export cables. The area potentially affected by MFs created by Vineyard Northeast’s offshore cables is likely too small to result in behavioral and/or displacement of cetaceans within the Offshore Development Area (Normandeau Associates et al. 2011; Gill et al. 2014; Copping et al. 2016). Accordingly, there is no expectation that MFs associated with either the HVDC or HVAC offshore export cables will cause significant population-level harm to either marine mammals or their magnetosensitive prey.

Given the likely benefits to some marine mammal species from increased prey abundance and the uncertain, but likely minimal negative impacts to marine mammals and their prey from MFs induced by power cables and from physical oceanographic changes related to structures in the water and extraction of wind energy, overall impacts to marine mammals resulting from long-term habitat alterations are anticipated to be negligible.

11 Mitigation Measures

For each project[14] developed within Lease Area OCS-A 0522, Vineyard Northeast will ensure the following mitigation measures are followed for all offshore operations. Throughout this section, foundation installation refers to impact pile driving, vibratory pile driving, and drilling.

11.1 General Measures

The following general measures will be implemented for all offshore operations.

11.1.1 Training

Vineyard Northeast will provide Site Induction Training to all vessel personnel, construction personnel, survey personnel, and the marine protected species monitoring team prior to the start of all in-water construction activities and as new personnel, as listed above, join Vineyard Northeast.

The marine protected species monitoring team includes protected species observers (PSOs), passive acoustic monitoring (PAM) analysts, and dedicated visual observers (VOs). PSOs visually monitor, detect, and identify marine mammals during each activity (i.e., foundation installation, UXO detonation, landfall site cofferdam installation and removal, and HRG surveys that use boomers, sparkers, or CHIRPs); all PSOs will be provided by a third party and will be approved by NMFS. Dedicated VOs visually monitor a vessel strike avoidance zone around the vessel and may be third party observers (i.e., PSOs) or trained, dedicated vessel crew members. PAM analysts monitor an acoustic data stream (i.e., pitch track data) from a PAM system to detect biological noise.

- All vessel personnel, construction personnel, survey personnel, and the marine protected species monitoring team will receive Protected Species Identification and Reporting training, Marine Trash and Debris Prevention training, Fisheries Protocols training, Dedicated Visual Observer (VO) training, Vessel Speed and Vessel Strike Avoidance training, and Communications training. The course curriculum will be further detailed within the Marine Protected Species Monitoring Plan.
- Vineyard Northeast will provide all project personnel with training consistent with the requirements of the LOA. This LOA training will be recorded on a course log sheet. The course log sheet will be reported to NMFS, as detailed below in the reporting section (Section 13.2).
- The third-party PSO and PAM analyst provider(s) will provide a suite of formal observer and analyst training, which will be further detailed in the Marine Protected Species Monitoring Plan after contract or subcontract award, but prior to in-water construction. In addition to the Vineyard Northeast Site Induction Training, all PSOs and PAM analysts will receive a standard suite of training from the PSO and PAM analyst provider, which may include, but is not necessarily limited to PSO Certification training and project-specific construction training. The standard training will also include a two-day refresher training course with the respective PSO and PAM

[14] Where used in this section, the term “project” refers to either Project 1 or Project 2.

analyst provider and attended by at least one Vineyard Northeast Project Compliance representative prior to the start of in-water construction activities each year.

- All PSO and PAM analysts as well as PSO and PAM provider Project Leads and Project Managers will participate in a Vineyard Northeast lead Rehearsal of Concept (ROC) style drill with the Vineyard Northeast Compliance team and relevant engineering personnel prior to the start of in-water activities. ROC drills will be designed to test the knowledge of all project personnel to ensure in-depth understanding of all permit requirements, including the LOA, particularly in complex scenarios.

11.1.2 Communication

Vineyard Northeast will ensure the following communication protocols are followed by all vessel operators, construction personnel, the marine protected species monitoring team, and survey personnel.

- Any visual sighting/observation or acoustic detection of a marine protected species (e.g., large whale) by project personnel will be communicated immediately to any on-duty PSO, PAM analyst(s), and all vessel captains immediately via the project's Situational Awareness System. If connectivity prohibits access to the project's Situational Awareness System, the detection will be communicated via VHF radio or cellular device to the Marine Coordination Center (MCC) who will report it in the project's Situational Awareness System. Any marine protected species detections by PSOs will be communicated to the Lead PSO immediately via VHF radio/or alternative communication platform. The Lead PSO will notify the Operations Manager (i.e. Pile Driving Operations Manager) and Client Representative.
- Vessel operators will review the project's Situational Awareness System each day prior to the first transit of the day for awareness of recent sightings.
- Vineyard Northeast will instruct all vessel personnel regarding the authority of the PSOs and PAM analysts.
- Any disagreement between the Lead PSO and the activity operator, PAM analyst, or another PSO regarding mitigation will only be discussed after the mitigative action has occurred.

11.1.3 Vessel Identification

Vineyard Northeast will ensure all project vessels are appropriately identified as detailed below.

- All project vessels will be equipped with an operational Automatic Identification System (AIS) device.
- All project vessel Maritime Mobile Service Identity (MMSI) numbers will be reported to NMFS OPR.

11.1.4 Vessel Strike Avoidance Procedures

Vineyard Northeast will ensure that all project vessels adhere to the following vessel strike avoidance measures while in the specified geographic region (see Section 2.2), unless an emergency[15] situation arises, as detailed below.

[15] An emergency is defined as an unanticipated serious event requiring immediate action to avoid, subdue, or remedy harm.

- All vessel operators and dedicated VOs will maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course to avoid striking any marine mammal.
- PSOs, vessel operators, and any dedicated VOs will monitor available NARW reporting systems (e.g., WhaleAlert app, WhaleMap app, the project's Situational Awareness System, Right Whale Sighting Advisory System [RWSAS], USCG VHF Channel 16) for the presence of NARWs prior to and every four (4) hours throughout the duration of any in-water activities and vessel operations. Vessel operators will monitor available sources of information regarding NARW presence in or near the project area including daily monitoring of the RWSAS, monitoring of the USCG VHF Channel 16 throughout the day for vessel speed restriction notifications (i.e. Dynamic Management Area [DMA], Seasonal Management Areas [SMA], Slow Zones), and any other information regarding NARW sighting locations for situational awareness (i.e., the project's Situational Awareness System).
- All underway vessels operating at any speed will employ a dedicated VO on-duty at all times to monitor for marine mammals within a 180-degree direction of the forward path of the vessel (90° port to 90° starboard). The dedicated VO will be located at the best vantage point (while considering observer safety) to ensure vessels are maintaining appropriate separation distances.
- Dedicated VOs will be equipped with alternative monitoring technologies (i.e., night vision devices, infrared cameras) to aid visual monitoring during periods of limited visibility (i.e., darkness, rain, fog).
- Dedicated VOs will have no other responsibility while observing for marine mammals.
- All project-associated vessels will adhere to the following minimum separation distances:
    - **NARW and unidentified large whales:** At least 500 m will be maintained between all vessels and all NARWs.
        - All vessels will comply with the NARW approach restrictions at 50 CFR Part 224.103(c).
        - If underway, the vessel operator will steer a course away from any sighted NARW at 10 knots or less to avoid violating the separation distance.
        - If a NARW is sighted within 500 m of the underway vessel, the vessel operator will turn away from the whale, reduce speed, and shift engine(s) to neutral and will not re-engage the engine until the whale has moved outside of the vessels path and beyond the separation distance.
        - If a large whale is sighted but its species cannot be confirmed as not a NARW, the vessel operator must assume that it is a NARW and take appropriate action.
    - **Sperm whales, *Kogia spp.*, beaked whales, and non-NARW baleen whales:** At least 100 m will be maintained between all vessels and all sperm whales, *Kogia spp.*, beaked whales, and non-NARW baleen whales.
        - If a sperm whale, *Kogia spp.*, beaked whale, or non-NARW baleen whale is sighted within 100 m of the transiting vessel, the vessel will turn away from the whale, reduce speed, and shift the engine(s) to neutral. The engine(s) will not be engaged again until the whale has moved outside of the vessel's path and beyond 100 m.

  - **Delphinid cetaceans and pinnipeds:** At least 50 m will be maintained between all vessels and delphinid cetaceans or pinnipeds (with an exception for those approaching the vessel [e.g., bow-riding dolphins])
    - If a delphinid cetacean or pinniped is sighted within 50 m of the transiting vessel, the vessel will turn away from the animal(s), reduce speed, and shift the engine(s) to neutral, except for those animals that approach the vessel (e.g., bow-riding dolphins). The engine(s) will not be engaged again until the animal(s) has moved outside of the vessel's path and beyond 50 m.
- Vessel operators will take action, as necessary, to avoid violating the relevant separation distances described above (e.g., attempt to remain parallel to the animal's course, slow down, avoid excessive speed or abrupt changes in direction until the animal has left the area), if a marine mammal(s) is sighted. If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed, turn away from the animal, and shift the engine to neutral, not engaging the engines until animals are clear of the area. It should be noted, this requirement does not apply when taking such a measure would threaten the safety of the vessel or crew (e.g., a vessel towing gear, any vessel that is navigationally constrained).
- Vessels will not divert or alter course to approach any marine mammal.
- All vessel strike avoidance measures will be followed, unless a deviation is necessary to maintain safe maneuvering speed and is justified due to naturally occurring phenomena that severely restricts the maneuverability of the vessel (i.e., meteorological conditions); or an emergency presents a threat to the health, safety, or life of a person; or when a vessel is actively engaged in an emergency rescue or response duty (i.e., vessel in distress, environmental crisis response).

The Marine Protected Species Monitoring Plan will include detailed information regarding vessel strike avoidance.

11.1.5 Vessel Speed Restrictions

Vineyard Northeast will ensure that all project vessels adhere to the following vessel speed restrictions.

- All vessel operators will abide by existing applicable vessel speed regulations (50 CFR Part 224.105) and will not be exempt from these regulations regardless of the provisions authorized in the LOA.
- Year-round:
  - A dedicated VO or PSO who has undergone Vineyard Northeast Site Induction Training will be stationed on all transiting vessels, regardless of size and speed, to monitor for marine mammals.
  - Vessel speeds will be immediately reduced to 10 knots or less when a mother/calf pair, pods, or large assemblages of cetaceans are observed within 500 m of an underway vessel.
  - If any NARW(s) is sighted at any distance by any project personnel or acoustically detected by any project-related PAM system, all vessel operators will immediately reduce vessel speed to 10 knots or less for at least 24 hours, regardless of vessel size. Each subsequent observation or acoustic detection in the project area shall trigger an additional 24-hour period.

    - If a NARW is reported by project personnel or via any of the monitoring systems (i.e., RWSAS, USCG VHF Channel 16, the project's Situational Awareness System) in the project area (i.e., the Lease Area and associated transit lanes), the vessel operator will reduce speeds to 10 knots or less for 24 hours following the reported detection.
- Time of year/seasonal restrictions:
    - All vessels, regardless of size, will transit at 10 knots or less in any Seasonal Management Areas (SMAs), Dynamic Management Areas (DMAs), and Right Whale Slow Zones.
    - From **October 15 to May 31**, project vessels, regardless of size, will not travel over 10 knots in the specified geographical region, see Section 2.2 (except for Nantucket Sound, and Long Island Sound, which have been demonstrated by best available science to not provide consistent habitat for NARWs), and will transit at 10 knots or less within any active Right Whale Slow Zone, DMA, or SMA.
    - From **June 1 to October 14**, project vessels may travel greater than 10 knots (if no speed restrictions [i.e., DMA, SMA, Slow Zone] are enacted) within a transit corridor (to and from a port to the Lease Area), if in addition to the required dedicated VO monitoring, real-time PAM monitoring of the transit corridor is conducted prior to and during the transit. If a NARW is visually or acoustically detected within or approaching the transit corridor, all vessels in the transit corridor will travel at 10 knots or less for 24 hours following the detection. The 24-hour slow down will reset for each subsequent detection. Speeds may be increased above 10 knots again once no further visual or acoustic detection in the transit corridor has occurred in the past 24-hours and the dedicated VO and real-time PAM monitoring continues along the transit corridor.

The Marine Protected Species Monitoring Plan will provide detailed information regarding vessel speed restrictions.

11.2 Sound Field Verification

11.2.1 Foundation Installation

Vineyard Northeast will conduct Sound Field Verification (SFV) for foundation installation as follows:

- For the first construction year of each project, thorough SFV will be conducted as applicable for the first 3 monopiles installed with only an impact hammer; the first 3 monopiles installed with a vibratory hammer followed by an impact hammer; the first 2 jacket foundations (all pin piles) installed; the first foundation (regardless of type) where relief drilling is used; and, the first foundation for any foundation scenarios that were modeled for the exposure analysis (e.g., rated hammer energy, number of strikes, representative location) that does not fall into one of the previously listed categories.
- For any subsequent construction year, thorough SFV will be conducted on the first monopile and first jacket foundation (all pin piles) if there are no changes to the pile driving equipment (i.e., same hammer, same Noise Attenuation System); the thorough SFV requirements described above for the first construction year will apply to any subsequent construction year if a revised FDR/FIR or other information is submitted to BOEM and BSEE that details changes to the equipment (e.g., different

hammer, different noise attenuation system) or if any foundation type or technique included in the requirements for the first construction year was not installed until a subsequent construction year.

- Thorough SFV will be conducted for the first pile (monopile or pin piles) installed during the month of December.
- If any interim thorough SFV measurement report indicates that the modeled distances to the isopleths of concern, assuming 10-dB attenuation, are exceeded, Vineyard Northeast will implement additional or modify the noise attenuation system or measures or enact operational changes to reduce sound levels to at or below the modeled distances on all subsequent foundations. Vineyard Northeast will also expand the exclusion zone sizes (i.e., clearance and shutdown zone sizes; see Sections 11.6 and 11.7) to match the noise levels. Thorough SFV may be conducted to demonstrate that the noise levels have returned to or below the modeled ranges assuming 10 dB of attenuation.
    - If harassment zones are expanded beyond an additional 1,500 m, additional PSOs will be deployed on additional platforms with each observer responsible for maintaining watch for no more than 180 degrees of an area with a radius no greater than 1,500 m.
- Vineyard Northeast will conduct abbreviated SFV for all foundation installations where thorough SFV monitoring is not carried out. Abbreviated SFV includes a single acoustic recorder deployed at an appropriate distance from the pile (e.g., 750 m). Results will be included in the weekly reports (see Section 13.2.6). Any indications that the distances to the identified Level A harassment and Level B harassment thresholds for marine mammals were exceeded will be addressed in a report that includes an explanation of factors that contributed to the exceedance and corrective actions that were taken to avoid exceedance on subsequent piles. Corrective actions could include:
    - Deployment of additional PSOs via additional platforms (e.g., PSO support vessels, deployment of drones monitored by PSOs) for any exceedance greater than 1,500 m;
    - Correction of any issues with the NAS system that may have contributed to the exceedance; and/or
    - Adjustments to the free air delivery of bubble curtains, if possible, or use of additional compressors as necessary and as space allows, as applicable.
- Vineyard Northeast will report weekly regarding the abbreviated SFV results and make additional corrections as necessary.

More information regarding SFV measurement, deployment strategy, hydrophone sensitivity, and calibration will be included in the Sound Field Verification Plan.

11.2.2 UXO Detonation

Vineyard Northeast will conduct SFV for any UXO detonation as follows:

- Thorough SFV will be conducted at a minimum of three locations (at two water depths at each location) from each detonation in a direction towards deeper water.
- Interim SFV reports will be submitted to NMFS within 48 hours after each UXO detonation as further detailed in the reporting section below.

More information regarding SFV during UXO detonation will be included in the Sound Field Verification Plan.

11.2.3 WTG Operations

Vineyard Northeast will conduct thorough SFV on one operational WTG to estimate WTG operational source levels and transmission loss rates in accordance with the Sound Field Verification Plan.

11.3 Operational Restrictions

Vineyard Northeast will ensure the following operational limitations are followed by its Contractors for each specified activity.

11.3.1 Foundation Installation

- During all foundation installation, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles will be used.
- Hammer energy will not exceed 8,000 kJ for monopile installation and 3,500 kJ for pin pile installation.
- Foundation installation will not occur simultaneously within the Lease Area (i.e., only one foundation will be installed at a given time).

11.3.2 UXO Detonation

- UXO detonations will only occur if no other means of removal is practicable.
- Only one detonation will occur within a 24-hour period.

11.3.3 HRG Surveys

The following measures apply to HRG surveys that use boomers, sparkers, or CHIRPs.

- Sub-bottom profilers (i.e., boomers, sparkers, and Compressed High Intensity Radiated Pulse [CHIRPS]) will be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing.
- Acoustic sources will be operated at the lowest practicable source level to meet the survey objective, when in use, and will be turned off when they are not necessary for the survey.

11.3.4 Fisheries Monitoring Surveys

- Survey gear will be deployed as soon as possible once the vessel arrives on station.
- Gear will not be deployed if there is a risk of interaction with marine mammals.
- Gear may be deployed after 15 minutes of no marine mammal sightings within 1 nautical mile (NM; 1,852 m) of the sampling station.
- If a marine mammal(s) is sighted within 1 NM (1,852 m) of the planned location and 15 minutes before gear deployment, the gear deployment will be suspended until there are no sightings of marine mammals for at least 30 minutes within 1 NM of the sampling station or the vessel operator will move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammal(s) are still visible from the vessel, the vessel operator will move again or skip the station.

- If a marine mammal is at risk of interacting with deployed gear, all gear will be immediately removed from the water. If marine mammals are sighted before the gear is fully removed from the water, the vessel will slow its speed and maneuver the vessel away from the animals to minimize potential interactions with the observed animal.
- All fisheries monitoring gear will be fully cleaned and repaired (if damaged) prior to each use/deployment.
- All fixed gear will comply with the Atlantic Large Whale Take Reduction Plan regulation (50 CFR § 229.32) during fisheries monitoring surveys.
- Trawl tows will not exceed a maximum of 20-minute trawl time.
- Gear will be emptied as close to the deck/sorting area and as quickly as possible after retrieval.
- All fisheries survey-related lines will have a breaking strength of less than 1,700 pounds, which can be accomplished using whole buoy lines or buoy lines with weak inserts that result in having an overall breaking strength of 1,700 lbs.
- Vineyard Northeast anticipates committing to the use of on-demand gear[16] for all fixed fishing surveys. Vineyard Northeast will investigate safe and effective on demand gear technology with the goal of eliminating all vertical lines from fixed fishing gear surveys.
- For vertical line surveys, buoys lines will be weighted and will not float at the surface of the water. Buoy lines will utilize weak links that cleanly break leaving behind the bitter end of the line that is free of any knots.
- Buoys, toggles, or other floatation devices will not be connected to groundlines. All groundlines will consist of sinking lines only.
- All in-water survey gear, including buoys, will be labeled with the scientific permit number or identification (ID) as Vineyard Northeast's research gear. All labels and markings on the gear, buoys, and buoy lines will also be compliant with the applicable regulations and all buoy markings will comply with instructions received from GARFO.
- All survey gear will be removed from the water whenever not in active survey use (i.e., no wet storage).
- All reasonable efforts that do not comprise human safety will be undertaken to recover gear.

11.4 Temporal Restrictions

11.4.1 Foundation Installation

11.4.1.1 Seasonal Restrictions

Once construction begins, the Proponent would proceed as rapidly as possible while implementing all required mitigation and monitoring measures, to reduce the total duration of construction. While the duration to drive each monopile or jacket pin pile would only take a few hours (see Table 13), the time required to set up/prepare for pile driving varies significantly with weather and sea state conditions.

[16] On-demand gear, also called "ropeless" systems, use far less rope in the water than traditional gear designs. The main characteristic of on-demand gear is that it does not need a rope attached to a buoy at the water's surface to locate and haul (retrieve) gear. See: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/developing-viable-demand-gear-systems

Between piling events, several factors are anticipated to further reduce the time available for foundation installation. In particular, it is reasonable to assume that approximately 30% or more of the time during which pile driving is proposed (as described below) would be unavailable due to weather conditions. Additional delays are likely due to the presence of protected species, equipment downtime and/or supply chain issues, other mariners' activities in the Lease Area, and delays in other project operations upon which pile driving is contingent (e.g., vessel-to-vessel transfers of crew, equipment, and materials that must occur during good weather conditions). Therefore, the Proponent expects to need the entire timeframe during which pile driving is currently proposed (as described below) to install the foundations included in each year of each construction schedule. Any expansion of the proposed seasonal restrictions on foundation installation described below would likely cause the foundation installation campaign to extend across additional years, requiring additional mobilization of the foundation installation vessel spread. As there is a "learning curve" period at the beginning of each foundation installation campaign, extending foundation installation across more years is expected to increase the total duration of construction. There would also be an overall increase in vessel traffic, which could also increase potential impacts to NARW and other marine mammals.

Seasonal Restrictions within the entire Lease Area and booster station aliquot:

- **December 1 - May 31:** Vineyard Northeast will establish a restriction on foundation installation (i.e., impact pile driving, vibratory pile driving, and drilling) between December 1 and May 31. An exception, as detailed below, may be made for foundation installation during the month of December outside of the NARW Enhanced Mitigation Area (the NARW Enhanced Mitigation Area is defined as within 20 km [12.4 miles] of the 30-m isobath on the western side of Nantucket Shoals), as approved by NMFS.
- **July 1 – October 14:** If approved, nighttime-initiated pile driving will only occur between July 1 and October 14 (see Section 11.4.1.3).

Seasonal Restrictions outside of the NARW Enhanced Mitigation Area:

- **December:** Foundation installation (i.e., impact pile driving, vibratory pile driving, and drilling) will not occur in December, unless it is necessary to complete the project within a given year, and only outside of 20 km of Nantucket Shoals, and as approved in advance by NMFS. Vineyard Northeast will notify NMFS in writing by September 1 of any year that pile driving or drilling cannot be avoided in December, and circumstances are expected to necessitate pile driving or drilling in December. If foundation installation is approved for December, the project will follow the enhanced monitoring and mitigation protocols in the Enhanced Mitigation Plan (see Section 13.1.3.4) to minimize the risk of exposure of NARWs to foundation installation noise, including noise from daily pre-construction surveys.
- **October 15 – December 31:** Outside of the NARW Enhanced Mitigation Area, if three or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan (see Section 13.1.3.4), if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.

Seasonal Restrictions within the NARW Enhanced Mitigation Area:

- **October 15 – May 31:** For piles installed within the NARW Enhanced Mitigation Area, foundation installation will not occur from October 15 to May 31.

11.4.1.2 Daily Restrictions

- Foundation installation will not commence until at least 1 hour after (civil) sunrise and will not be initiated within 1.5 hours of (civil) sunset, unless a NMFS-approved Nighttime Piling Alternative Monitoring Plan is implemented (see Section 11.4.1.3).
- No more than two monopiles or four pin piles for a single jacket will be driven per day, as technically feasible.[17]
- No simultaneous foundation installation will occur (i.e., only one foundation will be installed at a time).

11.4.1.3 Nighttime Restrictions (if approved)

- Foundation installation will only continue after dark when the installation of the same foundation began during daylight (1.5 hours before civil sunset), when clearance zones were fully visible for at least 30 minutes, and must proceed for human safety or installation feasibility reasons, unless NMFS approves the Nighttime Piling Alternative Monitoring Plan.
- Nighttime foundation installation (i.e., impact pile driving, vibratory pile driving, and drilling) will only occur in accordance with a NMFS-approved Nighttime Piling Alternative Monitoring Plan. Nighttime foundation installation is defined as foundation installation initiated between 1.5 hours prior to civil sunset until 1 hour after civil sunrise.

11.4.2 UXO Detonation

11.4.2.1 Seasonal Restrictions

Seasonal Restrictions outside of the NARW Enhanced Mitigation Area:

- **November 1 – May 31:** UXO detonations will not occur between November 1 and May 31 outside of the NARW Enhanced Mitigation Area.
- **October 15 – October 31:** Outside of the NARW Enhanced Mitigation Area, if any NARWs are visually observed or acoustically detected at any distance, no UXO detonation will occur until the following day.

Seasonal Restrictions within the NARW Enhanced Mitigation Area:

- **October 15 – May 31:** UXO detonations within the NARW Enhanced Mitigation Area will not occur from October 15 to May 31.

11.4.2.2 Daily Restrictions

- UXO detonations will only occur during daylight hours (1 hour after civil sunrise through 1.5 hours prior to civil sunset).

[17] The time required to set up/prepare for pile driving varies significantly with weather and sea state conditions; therefore, the extent to which two monopiles could be driven per day would be limited based on those factors.

- No more than one detonation will occur within a 24-hour period.

11.4.3 Cofferdam Installation and Removal

11.4.3.1 Daily Restriction

- Cofferdam installation and removal will only occur during daylight hours (1 hour after civil sunrise through 1.5 hours prior to civil sunset).

11.5 Noise Reduction

11.5.1 Foundation Installation

11.5.1.1 Noise Abatement System

- Vineyard Northeast will implement noise abatement systems (NAS), including at least two functional noise attenuation technologies, to reduce noise levels to the modeled harassment isopleths (assuming 10 dB attenuation), as shown in the Vineyard Northeast Underwater Acoustic and Exposure Modeling report (Appendix A) and assumed in this application.
- The NAS will be comprised of at least one far-field noise abatement system (i.e., a double Big Bubble Curtain [DBBC]) and one near-field (i.e., Hydro-sound Damper [HSD]) noise abatement system, maintained consistently to ensure optimal noise attenuation (i.e., BBC hose hole clearing). More information regarding the operation of the noise attenuation technologies will be provided in the Marine Protected Species Monitoring Plan.
- As research and development of new and emerging technologies prove more efficient and advanced NAS capabilities, Vineyard Northeast may request concurrence from NMFS to employ these more enhanced NAS technologies to support noise reduction during foundation installation, as further described in the Adaptive Management section below.

11.5.1.2 Soft Start

Vineyard Northeast will ensure that impact pile driving begins with a soft-start procedure as summarized below. To the extent technically feasible, soft start will be conducted for vibratory pile driving.

- Soft start will be implemented at the beginning of monopile and pin pile impact pile driving and at any time following the cessation of impact pile driving for 30 minutes or longer.
- For all monopile and pin pile impact pile driving, soft start will be implemented by performing no more than six strikes per one minute using hammer energies not to exceed 20% of the selected hammer’s maximum energy. The total soft start procedure time will be no less than 20 minutes.

11.5.2 UXO Detonation

- At least one NAS will be deployed to reduce noise levels, assuming 10 dB of attenuation, from any UXO detonation, while considering human safety.

11.5.3 HRG Surveys

- Prior to commencing HRG surveys using CHIRPs, boomers, and sparkers and after receiving confirmation from the PSOs that the clearance zone is clear of any marine mammals (see Section 11.6.4), acoustic sources will be gradually turned on (i.e., "ramp-up") to half power for 5 minutes prior to commencing full power, unless the equipment operates on a binary on/off switch (in which case ramp-up is not required).

11.6 Clearance

11.6.1 General Clearance Zone Measures

The following measures apply to clearance zones implemented during foundation installation, UXO detonation, HRG surveys that use boomers, sparkers, or CHIRPs, and cofferdam installation and removal.

- The activity will be delayed if a marine mammal from a species group for which authorization has not been granted, or a species for which authorization has been granted but the authorized take has been met, is observed entering or within the relevant clearance zone prior to beginning the activity. See Table 101 through Table 105 for a summary of species-specific clearance zones and clearance durations for each activity.
- If a marine mammal is observed within the relevant clearance zone, it will be allowed to remain in the area and leave of its own volition prior to commencing the activity.

11.6.2 Foundation Installation

- PSOs will begin monitoring 60 minutes prior to foundation installation, during, and for 30 minutes after the activity. Foundation installation will only commence when the minimum visibility zone (see Section 13.1.3.1) is fully visible (e.g., not obscured by rain, fog, etc.) for at least 30 minutes, as determined by the Lead PSO, and the clearance zones are clear of marine mammals for the species-specific clearance duration immediately prior to the initiation of foundation installation.
- Prior to foundation installation, a localized PAM detection of a marine mammal inside the species-specific clearance zone, or a detection that cannot be confirmed to be outside of the species-specific clearance zone, will result in a delay. See Table 101 and Table 102 for clearance durations.
- If a marine mammal(s) is observed entering or is observed within the clearance zones (Table 101 and Table 102) before foundation installation has begun, the activity will not commence until the animal(s) has exited the zone or a specific amount of time has elapsed since the last sighting. Specific time periods are 30 minutes for NARWs, 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species.

Table 101. Exclusion zones for impact and vibratory pile driving.[1]

Species/Species Group	Visual		Acoustic[2]	Visual and Acoustic Clearance Duration
	Clearance Zone (CZ)	Shutdown Zone (SZ)	PAM CZ & SZ	
North Atlantic right whale (NARW)	**Any distance**	**Any distance**	10 km	**June 1 – October 14**: Until 30 minutes (min) of visual and acoustic monitoring confirms no further detection of NARW(s) **October 15 – December 31**: Outside of the NARW Enhanced Mitigation Area, if three (3) or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan, if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.
Unidentified large whale	Any unidentified large whale sighted at any distance that cannot be identified to species as not a NARW is treated as a NARW for purposes of clearance and delay	Any unidentified large whale sighted at any distance that cannot be identified to species as not a NARW is treated as a NARW for purposes of a shutdown in foundation installation	10 km	See above

Species/Species Group	Visual		Acoustic[2]	Visual and Acoustic Clearance Duration
	Clearance Zone (CZ)	Shutdown Zone (SZ)	PAM CZ & SZ	
Other Mysticetes (humpback, fin, minke, sei, gray, & blue whales)	One monopile/day: 4.46 km; Two monopiles/day or one jacket: 5.01 km	One monopile/day: 4.46 km; Two monopiles/day or one jacket: 5.01 km	One monopile/day: 4.46 km; Two monopiles/day or one jacket: 5.01 km	30 minutes
Sperm whales	160 m	160 m	160 m	30 minutes
Risso's dolphins, pilot whales, killer whales, and false killer whales	160 m	160 m	160 m	30 minutes
Other delphinids (e.g., Atlantic white-sided dolphins, Atlantic spotted dolphins, common dolphins, common bottlenose dolphins, white-beaked dolphins)	160 m	160 m	160 m	15 minutes
Pinnipeds	Monopile: 700 m Pin pile: 1 km	Monopile: 700 m Pin pile: 1 km	Monopile: 700 m Pin pile: 1 km	15 minutes
Harbor porpoise	160 m	160 m	160 m	15 minutes

[1]Clearance and shutdown zones correspond to the Level A harassment threshold, except for the NARW and unidentified large whale, or are slightly larger. These zones may increase to accommodate the size of the far-field NAS (i.e., big bubble curtain); if that is the case, the Level A harassment zones for high-frequency cetaceans (HFCs) and mid-frequency cetaceans (MFCs) are typically smaller than the radial distance to the edge of the furthest far-field NAS (i.e., big bubble curtain).

[2]The PAM monitoring zone for all species/species groups is 10 km.

Table 102. Exclusion zones for drilling during foundation installation.[1]

Species/Species Group	Visual Clearance Zone (CZ)	Visual Shutdown Zone (SZ)	PAM CZ & SZ[2]	Visual and Acoustic Clearance Duration
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	Any distance	Any distance	10 km	**June 1 – October 14**: Until 30 minutes (min) of visual and acoustic monitoring confirms no further detection of NARW(s) **October 15 – December 31**: Outside of the NARW Enhanced Mitigation Area, if three (3) or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan, if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.
Low-frequency hearing group	150 m	139 m	150 m	30 minutes
Mid-frequency hearing group – large odontocetes (Risso's dolphins, pilot whales, killer whales, false killer whales)	50 m	20 m	50 m	30 minutes
Mid-frequency hearing group – small odontocetes (other dolphins)	50 m	20 m	50 m	15 minutes
High-frequency hearing group (harbor porpoise)	200 m	157 m	200 m	15 minutes
Pinnipeds (seals)	50 m	30 m	50 m	15 minutes

[1]Clearance and shutdown zones correspond to the Level A harassment threshold, except for the NARW and unidentified large whale, or are slightly larger.

[2]The PAM monitoring zone for all species/species groups is 10 km.

11.6.3 UXO Detonation

- PSOs will begin monitoring 60 minutes prior to UXO detonation, during, and for 30 minutes after the activity. UXO detonation will only commence when the minimum visibility zone (see Section 13.1.4.1) is fully visible (e.g., not obscured by darkness, rain, fog, etc.) for at least 30 minutes, as determined by the Lead PSO, and the clearance zones are clear of marine mammals for the species-specific clearance duration immediately prior to the initiation of detonation.
- If a marine mammal(s) is observed entering or is observed within the clearance zones (**Error! Reference source not found.**) before UXO detonation has begun, the activity will not commence until the animal(s) has exited the zone or a specific amount of time has elapsed since the last sighting. Specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species.
- Prior to UXO detonation, a localized PAM detection of a marine mammal inside the species-specific clearance zone, or a detection that cannot be confirmed to be outside of the species-specific clearance zone, will result in a delay.

Table 103. Exclusion zones for UXO detonations.[1,2]

Species/Species Group	Visual Clearance Zone	PAM Clearance Zone[3]
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	Any distance	Any distance
Low-frequency hearing group	5,500 m	5,500 m
Mid-frequency hearing group – large odontocetes (Risso's dolphins, pilot whales, killer whales, false killer whales)	1,000 m	1,000 m
Mid-frequency hearing group – small odontocetes (other dolphins)	1,000 m	1,000 m
High-frequency hearing group (harbor porpoise)	9,100 m	9,100 m
Pinnipeds (seals)	1,900 m	1,900 m

[1]Clearance zones correspond to the Level A harassment threshold (assuming 10 dB attenuation), except for the NARW and unidentified large whale, or are slightly larger. Because UXO detonations are instantaneous, no shutdown is possible; therefore, there are no shutdown zones for UXO detonations.

[2]UXO detonation may commence when the marine mammal(s) has voluntarily left the specific clearance zones and have been visually and acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species.

[3]The PAM monitoring zone is 10 km for all species/species groups.

11.6.4 HRG Survey

The following measures apply to HRG surveys that use boomers, sparkers, or CHIRPs.

- Vineyard Northeast will ensure clearance zones are established, monitored, and implemented for HRG surveys using visual monitoring (PSOs).
- Vineyard Northeast will follow the relevant Project Design Criteria (PDC 4, 5, and 7) of the programmatic consultation completed by NMFS' Greater Atlantic Regional Fisheries Office on June 29, 2021, revised September 2021, pursuant to Section 7 of the Endangered Species Act (ESA).
- HRG survey activities will only be initiated when the visual clearance zones are fully visible (i.e., not observed by fog, darkness, rain) for at least 30 minutes, as determined by the Lead PSO, and are clear of marine mammals for the species-specific clearance duration immediately prior to initiation of the equipment (i.e., HRG surveys that use boomers, sparkers, or CHIRPs), except for voluntary approach by small odontocetes (i.e., bow riding dolphins).
- If a marine mammal is observed within a clearance zone (see **Error! Reference source not found.**) during the clearance period, ramp-up or acoustic surveys may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sightings. The specific time period is 15 minutes for small odontocetes and pinnipeds, except for those voluntarily approaching the vessel (i.e., bow riding dolphins), and 30 minutes for all other species.
- Prior to a ramp-up procedure starting or activating acoustic sources, the acoustic source operator will notify a designated PSO of the planned start of ramp-up as agreed upon with the Lead PSO. The notification time will not be less than 60 minutes prior to the planned ramp-up or activation in order to allow the PSOs time to monitor the clearance zone(s) for 30 minutes prior to the initiation of ramp-up or activation (pre-start clearance). During this 30-minute pre-start clearance period, the entire applicable clearance zones must be visible.
- A PSO conducting pre-start clearance observations will be notified again immediately prior to reinitiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.
- A 30-minute clearance period of the clearance zones will be implemented immediately prior to the commencing of the survey or when there is more than a 30-minute break in survey activities or PSO monitoring. A clearance period is a period when no marine mammals are detected in the relevant zone.
- In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (infrared [IR]/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations will commence (i.e., no delay is required) despite periods of inclement weather and/or loss of daylight. Ramp-up will occur at times of poor visibility, including nighttime, only if appropriate visual monitoring has occurred with no detections of marine mammals in the 30 minutes prior to beginning ramp-up.

Table 104. Exclusion zones for HRG surveys.[1]

Species/Species Group	Visual Clearance Zone	Clearance Delay Duration	Shutdown Zone
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	500 m	30 mins	500 m
All other ESA-listed whales	500 m	30 mins	100 m
Humpback whale, minke whale	500 m	30 mins	100 m
Large odontocetes (Risso's dolphins, pilot whales, killer whale, false killer whale)	500 m	30 mins	100 m
Harbor porpoise	500 m	15 mins	100 m
Other small odontocetes (other dolphins)	500 m	15 mins[2]	100 m[3]
Pinnipeds (seals)	500 m	15 mins	100 m

[1]Applies to sparkers, boomers, and CHIRPS.

[2] Except for those voluntarily approaching the vessel (i.e., bow riding dolphins).

[3] 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 in this paragraph of this section is detected in the shutdown zone.

11.6.5 Cofferdam Installation and Removal

- Vineyard Northeast will ensure a clearance zone is established, monitored, and implemented for the installation and removal of cofferdams using visual monitoring (PSOs). These zones will be measured using the radial distance from the cofferdam being installed and/or removed. See **Error! Reference source not found.** for distances.
- PSOs will begin monitoring 60 minutes prior to cofferdam installation/removal, during, and for 30 minutes after the activity. Sheet pile installation/removal will only commence when visual clearance zones are fully visible (e.g., not obscured by darkness, rain, fog, etc.) for at least 30 minutes, as determined by the Lead PSO, and are clear of marine mammals for the species-specific clearance duration immediately prior to initiation of pile driving.
- If a marine mammal(s) is observed entering or is observed within the clearance zones, before vibratory pile driving has begun, the activity will not commence until the animal(s) has exited the zone or a specific amount of time has elapsed since the last sighting. Specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species.

Table 105. Exclusion zones for cofferdam installation and removal.[1]

Species/Species Group	Visual Clearance Zone	Visual Shutdown Zone
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	Any distance	Any distance
Low-frequency hearing group	5,000 m	64 m
Mid-frequency hearing group – large odontocetes (Risso's dolphins, pilot whales, killer whales, false killer whales)	50 m	14 m
Mid-frequency hearing group – small odontocetes (other dolphins)	50 m	14 m
High-frequency hearing group (harbor porpoise)	500 m	372 m
Pinnipeds (seals)	50 m	28 m

[1]For the low-frequency hearing group, except for the NARW and unidentified large whale, the clearance zone corresponds to the Level B harassment threshold during summer and the shutdown zone corresponds to the Level A harassment threshold. For the remaining species, the clearance zones and shutdown zones correspond to the Level A harassment threshold or are slightly larger.

11.7 Shutdown

11.7.1 In-water Heavy Machinery Operation

- When operating heavy machinery for in-water construction activities, if any marine mammal is on a path towards or comes within 10 meters of the equipment, operations will cease until the marine mammal has moved more than 10 m on a path away from the activity.

11.7.2 Foundation Installation

- Any large whale species that are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM shutdown zone that cannot be confirmed as a non-North Atlantic right whale will be treated as a NARW and trigger a shutdown.
- If a marine mammal is observed within the relevant shutdown zone (**Error! Reference source not found.** and **Error! Reference source not found.**), it will be allowed to remain in the area and will leave of its own volition.
- Foundation installation (i.e., impact pile driving, vibratory pile driving, or drilling) will cease immediately if a marine mammal from a species group for which authorization has not been granted, or a species for which authorization has been granted but the authorized take has been met, is observed entering or within the relevant shutdown zone, unless the shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability.
- If a marine mammal is detected (visual or acoustic) entering or within the relevant shutdown zone (**Error! Reference source not found.** and **Error! Reference source not found.**) after foundation installation (i.e., impact pile driving, vibratory pile driving, or drilling) has commenced, the PSO will request an immediate shutdown of the hammer or drill. An acoustic detection of a marine mammal that cannot be confirmed to be outside of the species-specific

shutdown zone will result in a shutdown. If a NARW is observed at any distance, the PSO will request an immediate shutdown of the hammer or drill. If the shutdown is deemed to be not technically feasible 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, or the lead engineer determines a risk of pile refusal or pile instability, then the potential to reduce hammer energy will be considered and implemented if the lead engineer determines it is technically feasible while considering the safety of the vessel crew.

- If a shutdown cannot be implemented, Vineyard Northeast will report the decision not to shut down pile-driving equipment to BOEM, NMFS, and BSEE within 24 hours of the decision, with a detailed explanation of the imminent risk presented and the animals potentially impacted. Vineyard Northeast will also document and report the decision not to shutdown to NMFS OPR within the monitoring report (i.e., weekly, monthly, and final monitoring reports).
- Following a shutdown, foundation installation will not re-commence until either the marine mammal has been confirmed to have left the relevant clearance zone voluntarily and is on a path away from the applicable zone and has been visually or acoustically confirmed beyond the clearance zone, or, when additional time has elapsed without re-detection, as follows:
  - After 15 minutes has elapsed with no further sightings or acoustic detections of small odontocetes and pinnipeds; or
  - 30 minutes for all other species.
  - If foundation installation was shut down due to the presence of NARW(s), foundation installation will not restart until the NARW(s) has been neither visually nor acoustically detected for 30 minutes. In cases where these criteria cannot be met, foundation installation will restart only if necessary to maintain pile stability and will be installed with the lowest hammer energy practicable to maintain stability as determined by the lead engineer.
  - From October 15 – December 31, outside of the NARW Enhanced Mitigation Area, if three or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan (see Section 13.1.3.4), if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.

11.7.3 HRG Surveys

The following measures apply to HRG surveys that use boomers, sparkers, or CHIRPs.

- Any large whale species that cannot be confirmed as a non-North Atlantic right whale will be treated as a NARW and trigger a shutdown.
- Consistent with Project Design Criteria 4, if a marine mammal is detected within or entering the respective shutdown zone (**Error! Reference source not found.**), acoustic sources will immediately be shut down, except in cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations will continue (i.e., no shutdown is required) only if marine mammals have not been detected.

- Shutdown is not required for small delphinids from the genera *Delphinus*, *Lagenorphynchus*, *Stenella*, or *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 will use their best professional judgment in making the decision to call for a shutdown.
- If an acoustic source has been shut down due to the presence of a marine mammal, the use of an acoustic source will not 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 sightings.
- If an acoustic source is shut down for a period longer than 30 minutes, all clearance and ramp-up procedures will be initiated. If an acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, acoustic sources may be activated again without ramp-up only if PSOs have maintained constant observation and no additional detections of any marine mammal occurred within the respective shut down zones.

11.7.4 Cofferdam Installation and Removal

- If a marine mammal is observed entering or within the respective shut down zone (see **Error! Reference source not found.**) after vibratory pile driving has begun, the PSO will call for a shutdown of pile driving. Pile driving will stop immediately unless: shutdown is not practicable due to imminent risk of injury or loss of life to an individual; if there is a risk of damage to the vessel that would create a risk of injury or loss of life for individuals; or if the lead engineer determines there is refusal or instability. In any of these situations, Vineyard Northeast will report the decision not to shut down pile-driving equipment to BOEM, NMFS, and BSEE within 24 hours of the decision, with a detailed explanation of the imminent risk presented and the animals potentially impacted. Vineyard Northeast will also document the reason(s) for not shutting down and report the information to NMFS OPR in the annual report (see Section 13.2). In cases where a shutdown is not feasible, pile driving may continue only if necessary to maintain stability at which time the lowest hammer energy practicable will be utilized to maintain stability.
- Vibratory pile driving will not restart until either the marine mammal(s) has voluntarily left the specific clearance zones (see **Error! Reference source not found.**) and has been visually confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings. The specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species.

11.8 PSO Authority

- All PSOs serving the project have the authority to call for a delay or shutdown of project activities and advise mitigation measures for vessel strike avoidance and speed restriction.
- If a PSO calls for a mitigatory action, Vineyard Northeast and its Contractors will perform the mitigatory action, unless the action would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability.
- Vineyard Northeast will ensure that all project personnel understand the PSOs authority.

- Any disagreement between the Lead PSO and the activity operator, PAM analyst, or another PSO regarding mitigation will only be discussed after the mitigative action has occurred.

12 Arctic Plan of Cooperation

This section of the application must be completed only for activities that occur offshore of Alaska and north of 60° N latitude. As described in Section 8, the proposed activities will take place off the US Northeast coast in the Atlantic Ocean and, therefore, will not have an adverse effect on the availability of marine mammals for subsistence uses.

13 Monitoring and Reporting

For each project[18] developed within Lease Area OCS-A 0522, Vineyard Northeast will ensure the following monitoring and reporting requirements are followed for all offshore operations. Throughout this section, foundation installation refers to impact pile driving, vibratory pile driving, and drilling.

13.1 Monitoring

13.1.1 General PSO Requirements

- Vineyard Northeast will ensure its Contractors employ independent, NMFS-approved, third-party PSOs that have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant crew with regard to the presence of protected species and mitigation requirements.
- All PSOs will either meet the education requirements detailed in the Marine Protected Species Monitoring Plan, or will have acquired relevant skills through a suitable amount of alternate experience as approved by NMFS OPR. All PSOs will demonstrate good standing and consistently good performance of all assigned duties.
- All PSOs will have visual acuity in both eyes (corrective vision is acceptable) to discern moving targets on the water surface at target size and distance (monitoring equipment included in capability). PSOs will also conduct field observations and collect data in accordance with the Marine Protected Species Monitoring Plan; PSOs will have sufficient training, orientation, or experience with construction operation to provide for personal safety during observations; PSOs will possess written skill sufficient to document observations and the ability to communicate orally, by radio, or in-person with project personnel to provide real-time information on marine mammals observed in the area.
- PSOs will be trained in Northwest Atlantic Ocean marine mammal identification and behaviors. PSOs will possess the ability to work with all required and relevant software and equipment for observations.
- All PSOs will have successfully completed a relevant training course within the last five years, including obtaining a certificate of course completion.
- Conditionally approved PSOs will serve on-active duty only if at least one unconditionally approved PSO is also available on the vessel.

[18] Where used in this section, the term “project” refers to either Project 1 or Project 2.

- At least one on-duty PSO for each activity (i.e., foundation installation, UXO detonation, landfall site cofferdam installation and removal, and HRG surveys that use boomers, sparkers, or CHIRPs) will be designated as the Lead PSO.
- Lead PSOs will have at least 90 days of current at-sea experience working in the Northwest Atlantic Ocean offshore performing a similar role, with the conclusion of the most recent relevant experience not more than 18 months previous. Lead PSOs may be either conditionally or unconditionally approved by NMFS.
- Vineyard Northeast or its Contractor will submit a list of previously approved PSOs to NMFS OPR for review and confirmation of approval for specific roles at least 30 days prior to the commencement of the activities or 15 days prior to when any new PSO joins the marine protected species monitoring team if activities have already commenced. For PSOs not previously approved, or for those PSOs for which the approval is not current, resumes and training documentation will be submitted to NMFS OPR for approval 60 days prior to the PSO joining the marine protected species monitoring team.
- PSOs, vessel operators, and any dedicated VOs will monitor available NARW reporting systems (e.g., WhaleAlert app, Whalemap app, the project's Situational Awareness System, USCG Channel 16) for the presence of NARWs prior to and every four (4) hours throughout the duration of any in-water activities and vessel operations. Vessel operators will monitor available sources of information of NARW presence in or near the project area, including daily monitoring of the RWSAS; monitoring of the USCG VHF Channel 16 throughout the day for vessel speed restriction notifications (i.e. DMA, SMAs, Slow Zones); and any other information regarding NARW sighting locations for situational awareness.
- PSOs will visually monitor for marine mammals prior to, during, and following all foundation installation, UXO detonation, cofferdam installation/removal, and HRG surveys that use boomers, sparkers, or CHIRPs (see Sections 11.6 and 11.7). Monitoring will be done while free from distractions and in a consistent, systematic, and diligent manner.
- PSO monitoring team will be stationed at the best vantage point(s) on any platform, as determined by the Lead PSO, to ensure 360-degree visual coverage of the entire clearance and shutdown zones around the activity area, and as much of the Level B harassment zone as possible.
- The Lead PSO will serve as the main point of contact with the on-duty PAM analyst(s) and construction personnel. The Lead PSO will also ensure communications from the on-duty PSO monitoring team are transmitted in real-time with the on-duty PAM analyst(s) and the on-duty construction personnel responsible for implementing mitigations (e.g., delay to foundation installation) to ensure communication on marine mammal observations can easily, quickly, and consistently occur between all on-duty PSOs, PAM analyst(s), and the construction personnel. PAM analysts will immediately communicate all acoustic detections of marine mammals to PSOs, including any determination regarding species identification, distance, and bearing (where relevant) relative to the pile being installed or UXO location and the degree of confidence (e.g., possible, probable detection) in the determination.
- PSOs will be equipped with high magnification (25x) binoculars, standard handheld (7x) binoculars, and digital single-lens reflex camera equipment and will utilize the naked eye to search continuously for marine mammals.

- PSOs will not exceed four consecutive watch hours; will have a minimum two-hour break between watches; and will not exceed a combined watch schedule of more than 12 hours in a 24-hour period. If the shift schedule includes PSOs on-duty for 2-hour shifts, a minimum 1-hour break between watches is required.
- PSOs will deploy alternative monitoring technology (i.e., infrared or thermal cameras) during periods of reduced visibility (i.e., darkness, rain, fog), as approved by NMFS through the Alternative Monitoring Plan and Nighttime Piling Alternative Monitoring Plan with the goal of monitoring the clearance and shutdown zones.
- As feasible, during daylight hours when equipment is not operating, PSOs will conduct observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring will be reflected in the monthly PSO monitoring reports.

13.1.2 General PAM Analyst Requirements

- Vineyard Northeast will ensure its Contractors employ independent, NMFS-approved, third-party PAM analysts that have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant crew with regard to the presence of marine protected species and mitigation requirements.
- All PAM analysts will either meet the education requirements detailed in the Marine Protected Species Monitoring Plan, or will have acquired the relevant skills through a suitable amount of alternate experience as approved by NMFS OPR. All PAM analysts will demonstrate good standing and consistently good performance of all assigned duties.
- All PAM analysts will have successfully completed a relevant training course within the last five years, including obtaining a certificate of course completion.
- Conditionally approved PAM analysts will have access to unconditionally approved PAM analysts while monitoring on active duty.
- Vineyard Northeast or its Contractor will submit a list of previously approved PAM analysts to NMFS OPR for review and confirmation of approval for specific roles at least 30 days prior to the commencement of the activities or 15 days prior to when any new PAM analyst joins the marine protected species monitoring team if activities have already commenced. For PAM analysts not previously approved, or for those analysts for which the approval is not current, resumes and training documentation will be submitted to NMFS OPR for approval 60 days prior to the PAM analyst joining the marine protected species monitoring team.
- PAM analysts will be located on a vessel or remotely onshore, and will utilize appropriate equipment (i.e., computer station equipped with a data collection software system and acoustic data analysis software) available wherever they are stationed, and data or data products will be streamed in real-time or in near real-time to allow PAM analysts to provide assistance to on-duty visual PSOs. During foundation installation and UXO detonation activities, the PAM analyst(s) will monitor to and past the clearance zone for large whales and will assist PSOs in ensuring full coverage of the clearance and shutdown zones.
- The PAM analyst will notify the Lead PSO(s) on duty of animal detections approaching or within applicable ranges of interest to the activity occurring in real-time via the project's Situational

Awareness System, VHF radio, or another communication platform (i.e., WhatsApp) who must be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (i.e., delay).

- PAM analysts will monitor the NMFS-approved PAM system as detailed in the PAM Plan.
- PAM analysts will review and classify acoustic detections (i.e., pitch track data) in real-time (prioritizing NARW and note detection of other cetaceans) during real-time monitoring periods (i.e., pre-clearance for pile driving and other activities).
- PAM analysts will ensure PAM detections and validation status are input into the data collection tool.
- PAM analysts will record and report marine mammal acoustic detections in accordance with permit conditions.
- PAM analysts will not exceed four consecutive watch hours; will have a minimum two-hour break between watches; and will not exceed a combined watch schedule of more than 12 hours in a 24-hour period. If the shift schedule includes PAM analysts on-duty for 2-hour shifts, a minimum 1-hour break between watches is required.

13.1.3 Foundation Installation

Sections 13.1.3.1 through 13.1.3.3 describe monitoring requirements during foundation installation from May 1 to November 30. If pile driving is required between the dates of December 1 to December 31, additional monitoring and mitigation measures will be employed as described in Section 13.1.3.4.

13.1.3.1 Visual Monitoring

- At least three on-duty PSOs will be on the installation vessel and on each of the two PSO support vessels (or monitoring an alternative monitoring platform) visually monitoring for marine mammals at least 60 minutes prior to, during, and 30 minutes after pile driving. If PSOs cannot visually monitor the minimum visibility zone (5 km) prior to foundation installation at all times using the equipment described below, foundation installation will not commence and will shutdown if already initiated.
- A minimum of two PSO support vessels, each utilizing three active on-duty PSOs will be employed. Alternatively, Vineyard Northeast will request NMFS approval to utilize alternative monitoring technology in lieu of one or more of the PSO support vessels to maintain similar marine mammal detection capabilities.
- At all times, at least one of the three on-duty PSOs will serve as Lead PSO.
- The PSO monitoring team will coordinate visual monitoring such that the PSO support vessels are located at the best vantage point (i.e., distance from the installation vessel) to observe and document marine mammal sightings in proximity to the exclusion zones.
- PSOs may not perform any other duty while on watch.
- PSOs will be located at the best vantage point(s) during vessel transit and on the piling platform in order to observe the extent of the clearance zone, while considering human safety.

- PSOs will enter all monitoring data into an Excel data sheet and basic detection information (e.g., spatial information) for marine mammal detections into an industry standard information solution (e.g., Mysticetus software).
- PSOs will be equipped with daytime visual monitoring equipment to aid the naked eye including hand-held reticule binoculars (7x) and high-magnification (25x) binoculars (i.e., “big eyes”) and digital single-lens reflex camera equipment. This equipment is part of the standard suite of visual monitoring equipment utilized by PSOs throughout the monitoring campaign.

13.1.3.2 Acoustic Monitoring

- Vineyard Northeast will utilize a NMFS-approved PAM system.
- A team of trained PAM analysts will monitor acoustic detections as detailed in the PAM Plan. During foundation installation, a minimum of one acoustic PAM analyst per acoustic data stream (equal to the quantity of acoustic buoys deployed or mobile systems) will be on active duty (remote onshore-based or offshore) from 60 minutes before, during, and for 30 minutes after all foundation installation activity concludes.
- A PAM system capable of detecting a NARW vocalization up to 10 km will be deployed and operated to monitor the PAM clearance and monitoring zones.
- The PAM system will not be located on the installation vessel to avoid interference. The PAM system components (i.e., acoustic buoys) will not be placed closer than 1 km (0.6 mi) from the pile being installed.
- Prior to foundation installation, under all circumstances, a PAM analyst will review the previous 24 hours of PAM data for situational awareness.
- PAM will be used in support of visual observations but is not the sole clearance method for exclusion zone establishment during periods of reduced visibility.

13.1.3.3 Alternative Monitoring

- Vineyard Northeast will deploy advanced alternative visual monitoring technologies (i.e., night vision, thermal, infrared, fixed IR cameras) to the PSOs actively monitoring on visual watches during foundation installation and use advanced PAM in the event of unexpected, poor visibility conditions (i.e., due to fog, precipitation, darkness), as determined by the Lead PSO on duty and as approved by NMFS through the Alternative Monitoring Plan and Nighttime Alternative Monitoring Plan. These technologies will include, at least:
    - Far-field visual monitoring:
        - Fixed camera technology: fixed IR cameras mounted aboard the main installation vessel and each PSO support vessel including monitors aboard each vessel.
    - Near-field visual monitoring:
        - Hand-held technology (i.e., night vision devices, thermal clip-ons, and/or thermal monocular)
    - Acoustic Monitoring:
        - PAM system deployed on appropriate platform(s) (i.e., mobile or fixed) for the environment and in consideration of safety and logistics

As research and development of new and emerging technologies prove more efficient and advanced monitoring capabilities, Vineyard Northeast may request concurrence from NMFS to employ these more enhanced alternative monitoring technologies or suite of technologies to support foundation installation during times of limited visibility, as further described in Section 13.3.

13.1.3.4 Enhanced Monitoring

In the unanticipated event that foundation installation is required between the dates of December 1 to December 31, additional monitoring measures will be employed during foundation installation to provide enhanced protection for the NARW, as described in the Enhanced Monitoring Plan. These additional measures are anticipated to include, at least:

- Increased PSO staffing levels
- Enhanced monitoring for NARWs
  - Extended installation delay for NARW(s) detection:
    - Outside of the NARW Enhanced Mitigation Area, if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO. If three or more NARWs are visually observed at any distance, no foundation installation will occur until the following day.
    - Any NARW acoustic detections (i.e., detected or possibly detected) that are localized inside the 10 km PAM clearance zone or cannot be confirmed to be outside of the 10 km PAM clearance zone, and that occurred on the day in which pile driving is planned, will either result in pile driving being postponed until the following day or a follow-up vessel-based or aerial survey.
- Follow-up PSO monitored vessel-based or aerial surveys following track lines for enhanced clearance should NARW(s) be detected during initial clearance measures.
- Continued acoustic monitoring, consistent with the Marine Protected Species Monitoring Plan, in coordination with the marine protected species monitoring team.

13.1.4 UXO Detonation

13.1.4.1 Visual Monitoring

- At least twelve on-duty PSOs will be deployed aboard four separate platforms (three PSOs on each platform) visually monitoring for marine mammals at least 60 minutes prior to, during, and 30 minutes after detonation. Alternatively, Vineyard Northeast will request NMFS approval to utilize alternative monitoring technology in lieu of two or more of the platforms to maintain similar marine mammal detection capabilities. If PSOs cannot visually monitor the minimum visibility zone (9.1 km) prior to detonation at all times using the equipment described below, detonation will not commence.
- At all times, on each platform, at least one of the three on-duty PSOs will serve as Lead PSO.

- The PSO monitoring team will coordinate visual monitoring such that the PSO support vessels and/or alternative monitoring technology platforms are located at the best vantage point (i.e., distance from the detonation operation) to observe and document marine mammal sightings in proximity to the exclusion zone.
- PSOs may not perform any other duty while on watch.
- PSOs will be located at the best vantage point(s) during vessel transit and on the platform in order to observe the extent of the clearance zone, while considering human safety.
- PSOs will enter all monitoring data into an Excel data sheet and basic detection information (e.g., spatial information) for marine mammal detections into an industry standard information solution (e.g., Mysticetus software).
- PSOs will be equipped with daytime visual monitoring equipment to aid the naked eye including hand-held reticule binoculars (7x) and high-magnification (25x) binoculars (i.e., "big eyes") and digital single-lens reflex camera equipment. This equipment is part of the standard suite of visual monitoring equipment utilized by PSOs throughout the monitoring campaign.

13.1.4.2 Acoustic Monitoring

- Vineyard Northeast will utilize a NMFS-approved PAM system.
- At least one PAM analyst will monitor an acoustic data stream as detailed in the PAM Plan, and will be on active duty (remote onshore-based or offshore) from 60 minutes before, during, and for 30 minutes after the detonation activity concludes.
- A PAM system capable of detecting a NARW vocalization up to 10 km will be deployed and operated to monitor the PAM clearance and monitoring zones.
- The PAM system will be deployed away from the UXO to be detonated to avoid interference, as described in the PAM Plan.
- Prior to detonation, under all circumstances, a PAM analyst will review the previous 24 hours of PAM data for situational awareness.

13.1.5 Cofferdam Installation and Removal

13.1.5.1 Visual monitoring

- At least two PSOs will serve on active duty watch during all activities related to the installation and removal of cofferdams with at least one PSO designated as the Lead PSO. Alternatively, Vineyard Northeast will request NMFS approval to utilize alternative monitoring technology in lieu of the monitoring platform to maintain similar marine mammal detection capabilities. If PSOs cannot visually monitor the minimum visibility zone (5 km) prior to cofferdam installation or removal at all times using the equipment described below, installation or removal will not commence.
- PSOs may be unconditionally or conditionally approved.
- PSOs will monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles, and for 30 minutes after all cofferdam installation or removal activities have ceased.

13.1.6 HRG Surveys

Vineyard Northeast will ensure PSOs utilize the following measures during HRG surveys using Compressed High Intensity Radiated Pulse (CHIRPs), boomers, and sparkers.

13.1.6.1 Visual Monitoring

- At least one PSO will be on active-duty monitoring during HRG surveys conducted during daylight (i.e., from 30 minutes prior to civil sunrise through 30 minutes following civil sunset) and at least two PSOs will be on active-duty monitoring during HRG surveys conducted at night.
- PSOs may be unconditionally or conditionally approved.
- PSOs will begin monitoring 30 minutes prior to activating acoustic sources, during the use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased.
- Any observations of marine mammals will be communicated to PSOs on all nearby survey vessels during concurrent HRG surveys.

13.1.7 Fisheries Monitoring Surveys

Vineyard Northeast will ensure the following measures are followed during all fisheries monitoring surveys.

13.1.7.1 Visual Monitoring

- Vessel captains and crew will be trained in marine mammal detection and identification as provided in the Vineyard Northeast Site Induction Training.
- Marine mammal monitoring will be conducted within 1 nautical mile from the planned survey location by the dedicated VO, vessel operator, scientific crew, or vessel crew aboard the fisheries survey vessel for at least 15 minutes prior to deploying gear, throughout the duration of gear deployment (unless on-demand gear), and for 15 minutes after haul back.
- Unless using on-demand gear, visual marine mammal monitoring effort will be conducted during the entire period of time that gear is in the water (i.e., throughout gear deployment, fishing, and retrieval).

13.2 Reporting

Vineyard Northeast will provide the following reports to NMFS.

13.2.1 Training Reports

- A record of the LOA training will be submitted to NMFS OPR at least 60 days prior to the start of in-water construction activities.
- Training course log sheets, including training confirmation, will be submitted to NMFS OPR prior to initiating in-water construction activities and within 30 days following the completion of training thereafter for any new vessel personnel joining the project.

13.2.2 Data Reporting Standards

- Vineyard Northeast will ensure its Contractors utilize a standardized reporting system during the effective period of the LOA. Data collected related to the project will be recorded using industry-standard software that is installed on field laptops and/or tablets (e.g., Mysticetus). All reports will be submitted to NMFS OPR (PR.ITP.MonitoringReports@noaa.gov), dates will be in MM/DD/YYYY format, and location information will be provided in Decimal Degrees and with the coordinate system information (e.g., NAD83, WGS84, etc.).

13.2.3 Visual Monitoring Effort and Detection Reporting Standards

- For all visual monitoring efforts and marine mammal sightings, the following information will be collected and reported to NMFS Office of Protected Resources: the date and time that monitored activity begins or ends; the construction activities occurring during each observation period; the watch status (i.e., sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform); the PSO who sighted the animal; the time of sighting; the weather parameters (e.g., wind speed, percent cloud cover, visibility); the water conditions (e.g., Beaufort sea state, tide state, water depth); all marine mammal sightings, regardless of distance from the construction activity; species (or lowest possible taxonomic level possible); the pace of the animal(s); the estimated number of animals (minimum/maximum/high/low/best); the estimated number of animals by cohort (e.g., adults, yearlings, juveniles, calves, group composition, etc.); the 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); the 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; the animal's closest distance and bearing from the activity and estimated time entered or spent within the Level A harassment and/or Level B harassment zone(s); the activity at time of sighting (e.g., pile driving, construction surveys), 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, etc.); the marine mammal occurrence in Level A harassment or Level B harassment zones; the 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 other human activity in the area.

13.2.4 Acoustic Detection Reporting Standards

- The following data will be recorded and reported to NMFS for all acoustic detections of marine mammals during PAM monitoring: location of hydrophone (latitude and longitude; in Decimal Degrees) and site name; bottom depth and depth of recording unit (in meters); recorder (model & manufacturer) and platform type (i.e., bottom-mounted, electric glider, etc.), and instrument ID of the hydrophone and recording platform (if applicable); time zone for sound files and recorded date/times in data and metadata (in relation to Universal Coordinated Time (UTC); i.e., Eastern Standard Time (EST) time zone is UTC5); duration of recordings (start/end dates and times; in International Organization for Standardization (ISO) 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ); deployment/retrieval dates and times (in ISO 8601 format); recording schedule (must be continuous); hydrophone and recorder sensitivity (in dB re. 1 microPascal [μPa]); calibration curve for each recorder; bandwidth/sampling rate (in Hz); sample bit-rate of recordings; and, detection range of equipment for relevant frequency bands (in meters);

  - For each detection, the following information will be recorded: species identification (if possible); call type and number of calls (if known); temporal aspects of vocalization (date, time, duration, etc.; date times in ISO 8601 format); confidence of detection (detected, or possibly detected); comparison with any concurrent visual sightings; location and/or directionality of call (if determined) relative to acoustic recorder or construction activities; location of recorder and construction activities at time of call; name and version of detection or sound analysis software used, with protocol reference; minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and name of PAM analyst(s) on duty.

13.2.5 Monitoring Reports

- Vineyard Northeast will submit weekly reports during foundation installation and UXO detonation activities to NMFS, BOEM, and BSEE documenting daily start and stop of all pile driving, drilling, and/or UXO detonation activities associated with the project; the start and stop of associated observation periods by PSOs; details on the deployment of PSOs; a record of all detections of marine mammals (acoustic and visual); 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 will be submitted the Wednesday for the previous week (Sunday to Saturday). The weekly report will also identify which WTGs become operational and when and will include a map. Weekly reports will cease upon completion of foundation installation and/or UXO detonation activities.
- Vineyard Northeast will submit monthly reports to NMFS OPR during foundation installation 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, MMSI number, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports will be submitted on the 15th of the month for the previous month. The monthly report will also identify which WTGs become operational and when, including a map. Full PAM detection data and metadata will also 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 at: https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reportingsystem-templates;
- Vineyard Northeast will submit a draft annual report to NMFS OPR no later than 90 days following the end of a given calendar year. The final annual report will be submitted within 30 calendar days following the receipt of any comments from NMFS on the draft report. The reports will include the following information: 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 zone(s) 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 actions was taken, why not; operational details (i.e., days and duration of impact, vibratory pile driving, and drilling, days, days and amount of

HRG survey effort, etc.); any PAM systems used; the results, effectiveness, and which noise attenuation systems were used during relevant activities (i.e., foundation installation); summarized information related to situational reporting; and any other important information relevant to the project, including additional information that may be identified through the adaptive management process.

- Vineyard Northeast will submit a draft 5-year report to NMFS, BOEM, and BSEE including all visual and acoustic monitoring conducted within 90 calendar days of the completion of activities occurring under the LOA. The final 5-year report will be submitted within 60 calendar days following receipt of any NMFS comments on the draft report.

13.2.6 Sound Field Verification Reporting

- Initial results of the thorough SFV measurements will be submitted to NMFS OPR, BOEM, and BSEE in an interim report after each foundation installation, and UXO detonation event, as soon as practicable and prior to any subsequent foundation installation or UXO detonation, but no later than 48 hours after each completed foundation installation or UXO detonation event. The report will include, as applicable, hammer energies/schedule used during pile driving, including, the total number of strikes and the maximum hammer energy; the model-estimated acoustic ranges (R95%) to compare with the real-world sound field measurements; peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90% of the acoustic energy (SPL_{rms}), and sound exposure level (SEL, in single strike for pile driving, SEL_{ss},), for each hydrophone, including at least the maximum, arithmetic mean, minimum, median (L50) and L5 (95% exceedance) statistics for each metric; estimated marine mammal Level A harassment and Level B harassment acoustic isopleths, calculated using the maximum-over-depth L5 (95% exceedance level, maximum of both hydrophones) of the associated sound metric; comparison of modeled results assuming 10-dB attenuation against the measured marine mammal Level A harassment and Level B harassment acoustic isopleths; estimated transmission loss coefficients; pile identifier name, location of the pile or UXO and each hydrophone array in latitude/longitude; depths of each hydrophone; one-third-octave band single strike SEL spectra; if filtering is applied, full filter characteristics will be reported; and hydrophone specifications including the type, model, and sensitivity. Vineyard Northeast will also report any immediate observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices. If any in-situ calibration checks for hydrophones reveal a calibration drift greater than 0.75 dB, pistonphone calibration checks are inconclusive, or calibration checks are otherwise not effectively performed, Vineyard Northeast will indicate full details of the calibration procedure, results, and any associated issues in the 48-hour interim reports.
- Vineyard Northeast will conduct abbreviated SFV for all foundation installations where thorough SFV monitoring is not carried out. Abbreviated SFV includes a single acoustic recorder deployed at an appropriate distance from the pile. Results will be included in the weekly reports. Any indications that the distances to the identified Level A harassment and Level B harassment thresholds for marine mammals were exceeded will be addressed with an explanation of factors that contributed to the exceedances and corrective actions that were taken to avoid exceedances on subsequent piles.

- Final results of all SFV measurements from each foundation installation, operational WTG monitoring, and UXO detonation will be submitted as soon as possible, but no later than 90 days following completion of all annual SFV measurements. The final reports will include all details included in the interim report and descriptions of any notable occurrences, explanations for results that were not anticipated, or actions taken during foundation installation. As applicable, the final report will also include at least the maximum, mean, minimum, median (L50) and L5 (95% exceedance) statistics for each metric; the SEL and SPL power spectral density and/or one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations will be reported; range of transmission loss coefficients; the 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); a description of depth and sediment type, as documented in the Construction and Operation Plan (COP), at the recording and foundation installation or UXO detonation locations; the extents of the measured Level A harassment and Level B harassment zone(s); hammer energies required for pile installation and the number of strikes per pile; the hydrophone equipment and methods (i.e., recording device, bandwidth/sampling rate; distance from the pile or UXO where recordings were made; the depth of recording device(s)); a description of the SFV measurement 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; the spatial configuration of the noise attenuation device(s) relative to the pile or UXO; a description of the noise abatement system and operational parameters (e.g., bubble flow rate, distance deployed from the pile or UXO, etc.), and any action taken to adjust the noise abatement system. A discussion which includes any observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices.

13.2.7 NARW Detection Reporting

13.2.7.1 Acoustic Detections

- Acoustic detections of all North Atlantic right whales at any time by a project-related PAM system will be reported as soon as possible to NMFS, but no longer than 24 hours after the detection via the 24-hour North Atlantic right whale Detection Template (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reportingsystem-templates).
- Full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction will be submitted within 90 calendar days following completion of activities requiring PAM for mitigation via the International Organization for Standardization (ISO) standard metadata forms available on the NMFS Passive Acoustic Reporting System website (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reportingsystem-templates). The completed data templates will be submitted to nmfs.nec.pacmdata@noaa.gov. The full acoustic recordings from real-time systems will also be sent to the National Centers for Environmental Information (NCEI) for archiving within 90 days following completion of activities requiring PAM for mitigation.

13.2.7.2 Visual Detections

- If a North Atlantic right whale is observed at any time by PSOs or project personnel, Vineyard Northeast will ensure the sighting is immediately (if not feasible, as soon as possible and no longer than 24 hours after the sighting) reported to NMFS, the US Coast Guard, and the RWSAS. If in the Northeast Region (Maine to Virginia/North Carolina border) call (866-755-6622). If circumstances arise where calling NMFS is not possible, reports will be made to the US Coast Guard via channel 16 or through the WhaleAlert app (http://www.whalealert.org/). The sighting report will include the time, date, and location of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), Lease Area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information.
- If a North Atlantic right whale is observed at any time by PSOs or project personnel, Vineyard Northeast will submit a summary report to NMFS Greater Atlantic Regional Fisheries (GARFO; nmfs.gar.incidentaltake@noaa.gov), NMFS Office of Protected Resources, and NMFS Northeast Fisheries Science Center (NEFSC; ne.rw.survey@noaa.gov) within 24 hours with the above information and the vessel/platform from which the sighting was made, activity the vessel/platform was engaged in at time of sighting, project construction and/or survey activity at the time of the sighting (e.g., pile driving, cable installation, HRG survey), distance from vessel/platform to sighting at time of detection, and any mitigation actions taken in response to the sighting.

13.2.8 Other Large Whale Detection Reporting

- If a large whale other than a North Atlantic right whale is observed at any time by PSOs or project personnel, Vineyard Northeast will ensure the sighting is reported to the WhaleAlert app (http://www.whalealert.org/).

13.2.9 Dead and Injured Mammal Reporting

- If personnel involved in the project discover a stranded, entangled, injured, or dead marine mammal, Vineyard Northeast will immediately report the observation to NMFS. If in the Greater Atlantic Region (Maine to Virginia), call the Northeast Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-6622) or use NOAA's Dolphin and Whale 911 App. Vineyard Northeast will report the incident to NMFS Office of Protected Resources (PR.ITP.MonitoringReports@noaa.gov) and to NMFS Greater Atlantic Regional Fisheries Office (GARFO; nmfs.gar.incidental-take@noaa.gov, nmfs.gar.stranding@noaa.gov), as soon as feasible but within 24 hours. The report (via phone or email) will include contact (name, phone number, etc.), the time, date, and location of the first discovery (and updated location information if known and applicable); species identification (if known) or description of the animal(s) involved; condition of the animal(s) (including carcass condition if the animal is dead); observed behaviors of the animal(s), if alive; if available, photographs or video footage of the animal(s); and general circumstances under which the animal was discovered.
- In the event of a vessel strike of a marine mammal by any vessel associated with the project or if project activities cause a non-auditory injury or death of a marine mammal, Vineyard Northeast will immediately report the incident to NMFS Greater Atlantic Region (Maine to Virginia) by calling the NMFS Greater Atlantic Stranding Hotline by phone (866-755-6622), emailing NMFS Office of Protected Resources (PR.ITP.MonitoringReports@noaa.gov), NMFS GARFO

(nmfs.gar.incidental-ake@noaa.gov, nmfs.gar.stranding@noaa.gov), as well as the U.S. Coast Guard via Channel 16. An incident report must be provided immediately to the above noted phone number and emails, NMFS OPR, GARFO (301-427-8401), BOEM and BSEE. Immediate notification is also required to NMFS Protected Resources Division (nmfs.gar.incidental-take@noaa.gov), BOEM renewable_reporting@BOEM.gov), BSEE (protectedspecies@bsee.gov) (Joint NTL 2023-N01 Appendix B) The report will include the time, date, and location of the incident; species identification (if known) or description of the animal(s) involved; vessel size and motor configuration (inboard, outboard, jet propulsion); vessel's speed leading up to and during the incident; vessel's course/heading and what operations were being conducted (if applicable); status of all sound sources in use; 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; environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; estimated size and length of animal that was struck; description of the behavior of the marine mammal immediately preceding and following the strike; if available, description of the presence and behavior of any other marine mammals immediately preceding the strike; estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); to the extent practicable, photographs or video footage of the animal(s); and Lessee and vessel information.

- Vineyard Northeast will immediately cease all on-water activities until the NMFS Office of Protected Resources 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. Vineyard Northeast will not resume activities until notified by NMFS OPR.

13.2.10Lost Fishing Gear Reporting

- Any lost gear associated with the fishery surveys will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division (nmfs.gar.incidentaltake@noaa.gov) as soon as possible or within 24 hours of the documented time of missing or lost gear. This report will include information on any markings on the gear and any efforts undertaken or planned to recover the gear.

13.3 Adaptive Management

Vineyard Northeast may request certain modifications to the LOA, for NMFS concurrence, if:

- If a technical issue arises that will knowingly create a deviation from the requirements of the Authorization prior to the initiation of the activity, Vineyard Northeast will submit a report including a description of the technical issue, the requirement potentially impacted, marine mammal detection information (if applicable), and the adaptive mitigation measures proposed in place of the impacted requirement.
- While such technical issues may arise during construction, unless necessary due to installation feasibility or to avoid imminent risk to human health and in consideration of safety, all technical issues will be addressed and resolved such that full compliance is achievable with the Authorization.
- If new or more advanced technologies become available and are effective and feasible for use, prior to activities undertaken pursuant to the LOA, Vineyard Northeast will endeavor to propose

the use of these technologies to NMFS for concurrence on the use of these technologies during specified activities.

14 Suggested Means of Coordination

Vineyard Northeast will coordinate the planned marine mammal monitoring program associated with construction activities off the US East Coast (as summarized in Section 11) with other parties that may have interest in the area and/or be conducting marine mammal studies in the same region during these activities. Vineyard Northeast regularly engages with regional stakeholders to ensure any use of the Lease Area for marine mammal research is deconflicted. To date, Vineyard Wind 1, an affiliate of Vineyard Northeast, has executed three deconfliction plan agreements with various federally funded research initiatives (e.g., Project WOW) and serves as an industry advisor on various User Advisory Boards for regional wildlife and habitat studies (e.g., RODEO II).

A Vineyard Northeast staff member serves as an industry caucus representative on the RWSC Steering Committee and regularly attends all RWSC subcommittee meetings. Additionally, Vineyard Northeast is a member of ROSA.

Vineyard Northeast is seeking to commit to the sole use of on demand gear for all fixed fishing gear-based surveys. Vineyard Northeast will promote research and development of safe and effective on demand gear technology with the goal of eliminating all vertical lines from Vineyard Northeast-funded fixed fishing gear-based surveys.

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Appendix A – Underwater Acoustic and Exposure Modeling Report

Appendix B – Alternate Take Estimates and Mitigation Zone Sizes Using NMFS (2024) Acoustic Guidelines

Appendix C – Distances to Acoustic Thresholds for High Resolution Geophysical Sources

Appendix B

Alternate Take Estimates and Mitigation Zone Sizes Using NMFS (2024) Acoustic Guidelines

Introduction

Vineyard Northeast LLC (the "Proponent") initially submitted an application for incidental take regulations and letter of authorization issuance for the construction and operations of Vineyard Northeast (the ITR and LOA application) in May 2024. Subsequent to the initial submission of this application, the National Marine Fisheries Service (NMFS) finalized updated *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (the "updated technical guidance") in October 2024 (NMFS 2024). The updated technical guidance includes revisions to both the marine mammal weighting functions and thresholds used to inform potential auditory injury (a form of Level A harassment) and temporary threshold shift (TTS, a form of Level B harassment). Additionally, the updated technical guidance includes the new marine mammal hearing group nomenclature proposed by Southall et al. (2019). As part of the review of Vineyard Northeast's pending ITR and LOA application, NMFS requested that the Proponent provide updated exposure/take estimates as well as mitigation zone sizes using the updated technical guidance. The activities affected by these updates are foundation installation (Level A harassment estimates and mitigation zone sizes) and potential unexploded ordnance (UXO) detonation (both Level A and Level B harassment estimates and mitigation zone sizes). No Level A take is being requested incidental to high-resolution geophysical surveys or landfall site cofferdam installation and removal, so these activities are not included in this appendix.

To assess the extent that the changes to NMFS' updated technical guidance would have on exposure/take estimates, JASCO updated acoustic assessments for these activities, applying the new criteria to produce revised acoustic ranges, exposure ranges, and exposure estimates for impact pile driving and revised acoustic ranges and exposure estimates for UXO detonation. The updated acoustic assessments are provided as an attachment to this appendix (Ozanich et al. 2024; Terry 2024).

As presented in this Appendix, these updated acoustic and exposure ranges and exposure estimates were used to calculate the revised take estimates and mitigation zones provided in the following sections. For ease of reference, the section and table numbers shown below are the same as the corresponding tables and figures in the body of the ITR and LOA application to which this appendix is attached.

Updated Acoustic Thresholds and Modeled Acoustic and Exposure Ranges

6.2.1 Level A Harassment Exposure Criteria

Table 1. NMFS (2024) PTS onset thresholds for impulsive sounds and non-impulsive sounds and TTS onset thresholds for impulsive sounds for the marine mammal functional hearing groups of species present in the Vineyard Northeast Offshore Development Area.

Marine Mammal Hearing Group	Generalized Hearing Range	Auditory Injury Thresholds (Non-impulsive Sounds)	Auditory Injury Thresholds (Impulsive Sounds)	TTS Onset Thresholds (Impulsive Sounds)
Low-frequency cetaceans (LF)	7 Hz to 36+ kHz	$L_{E,p,LF,24h}$: 197 dB	$L_{p,0\text{-}pk,flat}$: 222 dB $L_{E,p,LF,24h}$: 183 dB	$L_{p,0\text{-}pk,flat}$: 216 dB $L_{E,p,LF,24h}$: 168 dB
High-frequency cetaceans (HF)	150 Hz to 160 kHz	$L_{E,p,MF,24h}$: 201 dB	$L_{p,0\text{-}pk,flat}$: 230 dB $L_{E,p,MF,24h}$: 193 dB	$L_{p,0\text{-}pk,flat}$: 224 dB $L_{E,p,MF,24h}$: 178 dB
Very high-frequency cetaceans (VHF)	200 Hz to 165 kHz	$L_{E,p,HF,24h}$: 181 dB	$L_{p,0\text{-}pk,flat}$: 202 dB $L_{E,p,HF,24h}$: 159 dB	$L_{p,0\text{-}pk,flat}$: 196 dB $L_{E,p,HF,24h}$: 144 dB
Phocid pinnipeds (underwater) (PW)	40 Hz to 90 kHz	$L_{E,p,PW,24h}$: 195 dB	$L_{p,0\text{-}pk,flat}$: 223 dB $L_{E,p,PW,24h}$: 183 dB	$L_{p,0\text{-}pk,flat}$: 217 dB $L_{E,p,PW,24h}$: 168 dB

[a] PTS onset thresholds for impulsive sounds are used to define Level A harassment for impact piling, UXO detonation, and some HRG equipment. PTS onset thresholds for non-impulsive sounds are used to define Level A harassment for drilling, vibratory hammering, and non-impulsive HRG equipment. TTS onset thresholds for impulsive sounds are used to define Level B harassment for UXO detonation.
[b] Peak sound pressure level (L_p) is in units of dB re 1 µPa and cumulative sound exposure level ($L_{E,24h}$) is in units of dB re 1 µPa²·s.

6.3.3.5 Modeled Acoustic Ranges

Table 2. Modeled acoustic ranges ($R_{95\%}$) in kilometers (km) to PTS onset (Level A) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule A, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

		Acoustic Range (km)							
							WTG Jacket		ESP Jacket
		14 m Monopile 6600 kJ		14 m DTD Monopile 6600 kJ		14 m Monopile 8000 kJ	Pre-piled 4.25 m pin pile 3 per day	Pre-piled 4.25 m pin pile 4 per day	Post-piled 4.25 m pin pile 4 per day
Hearing Group	Level A Threshold[a]	Impact Only	Impact & Vibratory	Impact Only	Impact & Vibratory	Impact Only	Impact Only	Impact Only	Impact Only
Low-frequency cetacean	183	6.46	4.32	7.56	5.57	7.99	8.30	9.16	11.16
High-frequency cetacean	193	-	-	0.04	-	0.06	0.07	0.09	0.11
Very high-frequency cetacean (SEL_{cum})	159	0.03	-	0.06	-	0.08	0.71	0.75	0.97
Very high-frequency cetacean (SPL_{pk})[a]	202	0.19	0.19	0.19	0.19	0.20	0.12	0.12	0.13
Phocid pinniped in water	183	0.73	0.34	1.01	0.56	1.15	1.19	1.39	1.77

WTG = wind turbine generator, ESP = electrical service platform, which includes the booster station.
[a] For very high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range for monopile foundations. Both ranges are shown here for comparison.

Table 3. Modeled acoustic ranges ($R_{95\%}$) in kilometers (km) to PTS onset (Level A) sound exposure thresholds for marine mammals during pile driving of the different foundation types used in Schedule B, with 10 dB sound attenuation. Ranges are the longer of the two modeled sites, using the summer sound speed profile.

Hearing Group	Level A Threshold[a]	Acoustic Range (km): 14 m Monopile 8000 kJ, Impact Only	14 m Monopile 8000 kJ, Impact & Vibratory	WTG Jacket: Pre-piled 4.25 m pin pile 4 per day, Impact Only	ESP Jacket: Post-piled 4.25 m pin pile 4 per day, Impact Only
Low-frequency cetacean	183	7.99	5.70	9.16	11.16
High-frequency cetacean	193	0.06	-	0.09	0.11
Very high-frequency cetacean (SEL_{cum})[a]	159	0.08	0.02	0.75	0.97
Very high-frequency cetacean (SPL_{pk})[a]	202	0.20	0.20	0.12	0.13
Phocid pinniped in water	183	1.15	0.57	1.39	1.77

WTG = wind turbine generator, ESP = electrical service platform, which includes the booster station.

[a] For very high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range for monopile foundations. Both ranges are shown here for comparison.

Table 4. Modeled acoustic ranges ($R_{95\%}$) in meters (m) and predicted areas ensonified in square kilometers (km^2) to PTS onset (Level A) and behavioral (Level B) sound exposure thresholds for the different marine mammal hearing groups for potential drilling during foundation installation for the two model sites using the summer sound speed profile.

Hearing Group	Level A Threshold[a]	Range to Threshold (m) L01	Range to Threshold (m) L02	Ensonified Area (km^2) L01	Ensonified Area (km^2) L02
Low-frequency cetacean	197	184	136	0.113	0.061
High-frequency cetacean	201	14	14	<0.001	<0.001
Very high-frequency cetacean	181	71	54	0.016	0.010
Phocid pinniped in water	195	121	91	0.048	0.026
Hearing Group	**Level B Threshold**	**Range to Threshold (m) L01**	**Range to Threshold (m) L02**	**Ensonified Area (km^2) L01**	**Ensonified Area (km^2) L02**
All hearing groups	120	15,772	23,380	712.714	1,611.280

6.3.3.6 Modeled Exposure Ranges

Table 5. Exposure ranges ($ER_{95\%}$) to Level A sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule A, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

		Exposure Range (km)									
									WTG Jacket		ESP Jacket
		14 m Monopile 6600 kJ 1 pile per day		14 m Monopile 6600 kJ 2 piles per day		14 m DTD Monopile 6600 kJ 1 pile per day		14 m Monopile 8000 kJ 1 pile per day	Pre-piled 4.25 m pin pile 3 piles per day	Pre-piled 4.25 m pin pile 4 piles per day	Post-piled 4.25 m pin pile 4 piles per day
Hearing Group	Level A Threshold	Impact Only	Impact & Vibratory	Impact Only	Impact & Vibratory	Impact Only	Impact & Vibratory	Impact Only	Impact Only	Impact Only	Impact Only
Low-frequency cetacean	183										
Fin whale*		4.32	4.07	4.24	4.13	4.97	4.85	5.13	3.69	4.23	5.25
Humpback whale		3.75	3.74	4.14	4.12	4.31	4.18	4.87	3.01	3.46	4.44
Minke whale		3.10	3.10	3.09	3.08	3.63	3.63	3.75	1.77	2.09	2.58
North Atlantic right whale*		3.87	3.71	3.76	3.68	3.89	3.91	4.21	2.47	2.96	3.71
Sei whale*		3.24	3.23	3.32	3.29	3.61	3.46	4.00	2.02	2.14	2.70
High-frequency cetacean	193	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very high-frequency cetacean[a]	202	0.10	0.10	0.09	0.09	0.10	0.10	0.10	0.02	0.02	0.07
Phocid pinniped in water[b]	183	0.35	0.35	0.45	0.37	0.62	0.62	0.62	0.88	0.93	1.38

* Indicates species listed as endangered under the US Endangered Species Act.

[a] For very high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range, so SPL_{pk} is shown as the Level A range for this hearing group.

[b] For phocid pinnipeds, the largest exposure range for the two species is shown.

Table 6. Exposure ranges ($ER_{95\%}$) to Level A sound exposure thresholds[a] for marine mammals during installation of the different foundation types used in Schedule B, with 10 dB sound attenuation. All foundation installation occurs during months when the summer sound speed profile dominates, i.e., June-November, so only summer results are shown.

		Exposure Range (km)				
					WTG Jacket	ESP Jacket
		14 m Monopile 8000 kJ 1 pile per day		14 m Monopile 8000 kJ 2 piles per day	Pre-piled 4.25 m pin pile 4 piles per day	Post-piled 4.25 m pin pile 4 piles per day
Hearing Group	**Level A Threshold**	**Impact Only**	**Impact & Vibratory**	**Impact Only**	**Impact Only**	**Impact Only**
Low-frequency cetacean	183					
Fin whale*		5.13	4.45	5.36	4.23	5.25
Humpback whale		4.87	4.20	4.99	3.46	4.44
Minke whale		3.75	3.19	3.88	2.09	2.58
North Atlantic right whale*		4.21	4.05	4.57	2.96	3.71
Sei whale*		4.00	3.58	4.15	2.14	2.79
High-frequency cetacean	193	0.00	0.00	0.00	0.00	0.00
Very high-frequency cetacear	202	0.10	0.10	0.11	0.02	0.07
Phocid pinniped in water[b]	183	0.62	0.68	0.80	0.93	1.38

* Indicates species listed as endangered under the US Endangered Species Act.

[a] For very high-frequency cetaceans, the peak sound pressure level (SPL_{pk}) range was greater than the cumulative sound exposure level (SEL_{cum}) range, so SPL_{pk} is shown as the Level A range for this hearing group.

[b] For phocid pinnipeds, the largest exposure range for the two species is shown.

Updated Exposure and Take Estimates

Foundation Installation

6.3.4.1 Vineyard Northeast Full Buildout

Table 7. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule A, year 3 (2030), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule A – Year 3 (2030)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	25.18	0.03	50.45	28.64	2.0	26	51
Humpback whale	16.99	0.00	35.09	51.35	2.2	17	52
Minke whale	68.98	0.01	164.88	23.09	1.4	69	165
North Atlantic right whale*	5.05	0.01	13.35	2.97	2.0	6	14
Sei whale*	1.40	0.01	3.37	5.55	1.7	2	6
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	20.16	-	2.0	0	21
Atlantic spotted dolphin	0.00	0.00	17.05	1.11	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	587.25	3.00	19.1	0	588
Common bottlenose dolphin	0.00	0.00	588.30	216.23	13.0	0	589
Common dolphin	0.00	0.00	10747.06	1813.00	24.3	0	10748
Pilot whale, long-finned	0.00	0.00	61.89	24.72	6.2	0	62
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	77.62	1.33	12.0	0	78
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.87	269.92	-	2.5	3	270
Pinnipeds (PPW hearing group)							
Gray seal	0.68	0.00	58.50	14.67	1.4	1	59
Harbor seal	0.09	0.00	11.41	2.96	1.4	1	12

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback and sei whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 8. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule A, year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule A – Year 4 (2031)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	27.17	0.01	234.28	26.62	2.0	28	235
Humpback whale	18.86	0.00	138.39	47.72	2.2	19	139
Minke whale	82.43	0.02	454.74	21.46	1.4	83	455
North Atlantic right whale*	5.51	0.01	54.06	2.76	2.0	6	55
Sei whale*	1.52	0.01	12.95	5.16	1.7	2	13
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	67.30	-	2.0	0	68
Atlantic spotted dolphin	0.00	0.00	171.90	1.03	24.0	0	172
Atlantic white-sided dolphin	0.00	0.00	1793.83	2.79	19.1	0	1794
Common bottlenose dolphin	0.00	0.00	1616.59	200.96	13.0	0	1617
Common dolphin	0.00	0.00	32125.13	1685.03	24.3	0	32126
Pilot whale, long-finned	0.00	0.00	216.84	22.97	6.2	0	217
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	449.67	1.24	12.0	0	450
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	3.19	882.37	-	2.5	4	883
Pinnipeds (PPW hearing group)							
Gray seal	0.90	0.00	1040.50	13.63	1.4	1	1041
Harbor seal	0.07	0.00	95.73	2.75	1.4	1	96

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 9. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 2 (2029), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Full Buildout Schedule B – Year 2 (2029)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	16.73	0.04	29.77	14.15	2.0	17	30
Humpback whale	11.27	0.01	21.54	25.37	2.2	12	26
Minke whale	45.55	0.01	104.93	11.41	1.4	46	105
North Atlantic right whale*	3.39	0.01	8.45	1.47	2.0	4	9
Sei whale*	0.99	0.01	2.40	2.74	1.7	1	3
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	12.68	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	9.01	0.55	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	358.26	1.48	19.1	0	359
Common bottlenose dolphin	0.00	0.00	368.57	106.84	13.0	0	369
Common dolphin	0.00	0.00	6116.04	895.84	24.3	0	6117
Pilot whale, long-finned	0.00	0.00	38.25	12.21	6.2	0	39
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	45.02	0.66	12.0	0	46
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.36	161.22	-	2.5	3	162
Pinnipeds (PPW hearing group)							
Gray seal	0.61	0.00	43.45	7.25	1.4	1	44
Harbor seal	0.15	0.00	8.21	1.46	1.4	1	9

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 10. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 3 (2030), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Full Buildout Schedule B – Year 3 (2030)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	16.64	0.04	29.59	13.81	2.0	17	30
Humpback whale	10.97	0.01	20.93	24.77	2.2	11	25
Minke whale	44.96	0.01	103.34	11.14	1.4	45	104
North Atlantic right whale*	3.30	0.01	8.24	1.43	2.0	4	9
Sei whale*	0.95	0.01	2.31	2.68	1.7	1	3
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	12.47	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	8.36	0.54	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	346.33	1.45	19.1	0	347
Common bottlenose dolphin	0.00	0.00	361.69	104.30	13.0	0	362
Common dolphin	0.00	0.00	5940.69	874.51	24.3	0	5941
Pilot whale, long-finned	0.00	0.00	37.45	11.92	6.2	0	38
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	44.36	0.64	12.0	0	45
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.30	156.88	-	2.5	3	157
Pinnipeds (PPW hearing group)							
Gray seal	0.58	0.00	41.32	7.08	1.4	1	42
Harbor seal	0.14	0.00	7.82	1.43	1.4	1	8

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 11. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 4 (2031), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Full Buildout Schedule B – Year 4 (2031)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	17.55	0.02	123.65	14.83	2.0	18	124
Humpback whale	14.97	0.00	99.67	26.58	2.2	15	100
Minke whale	69.71	0.00	381.41	11.95	1.4	70	382
North Atlantic right whale*	5.02	0.01	37.50	1.54	2.0	6	38
Sei whale*	1.60	0.00	12.70	2.87	1.7	2	13
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	23.56	-	2.0	0	24
Atlantic spotted dolphin	0.00	0.00	30.24	0.58	24.0	0	31
Atlantic white-sided dolphin	0.00	0.00	1290.12	1.55	19.1	0	1291
Common bottlenose dolphin	0.00	0.00	836.54	111.93	13.0	0	837
Common dolphin	0.00	0.00	13749.88	938.50	24.3	0	13750
Pilot whale, long-finned	0.00	0.00	105.59	12.80	6.2	0	106
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	126.82	0.69	12.0	0	127
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.27	475.42	-	2.5	3	476
Pinnipeds (PPW hearing group)							
Gray seal	1.35	0.00	1021.09	7.59	1.4	2	1022
Harbor seal	0.12	0.00	62.43	1.53	1.4	1	63

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 12. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for the full buildout of Vineyard Northeast using installation Schedule B, year 5 (2032), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Full Buildout Schedule B – Year 5 (2032)	
Species	**PTS SEL_{cum}**	**PTS SPL_{pk}**	**Behavior**	**Based Estimate[a]**	**Group Size[b]**	**Level A Take**	**Level B Take[c]**
Mysticetes (LF hearing group)							
ale*	20.89	0.00	19.99	14.83	2.0	21	20
ack whale	17.00	0.00	20.30	26.58	2.2	17	27
Minke whale	87.54	0.00	132.75	11.95	1.4	88	133
tlantic right whale*	5.67	0.01	7.69	1.54	2.0	6	8
ale*	1.56	0.00	3.46	2.87	1.7	2	4
Odontocetes (HF hearing group)							
whale*	0.00	0.00	14.64	-	2.0	0	15
spotted dolphin	0.00	0.00	9.26	0.58	24.0	0	24
white-sided dolphin	0.00	0.00	491.23	1.55	19.1	0	492
on bottlenose dolphin	0.00	0.00	555.55	111.93	13.0	0	556
on dolphin	0.00	0.00	9407.19	938.50	24.3	0	9408
Pilot whale, long-finned	0.00	0.00	51.20	12.80	6.2	0	52
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
dolphin	0.00	0.00	63.04	0.69	12.0	0	64
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.32	198.61	-	2.5	3	199
Pinnipeds (PPW hearing group)							
eal	1.48	0.00	15.13	7.59	1.4	2	16
seal	0.07	0.00	6.75	1.53	1.4	1	7

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

6.3.4.2 Project 1

Table 13. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule A, year 3 (2030), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 1 Max Schedule A – Year 3 (2030)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	25.18	0.03	50.45	28.64	2.0	26	51
Humpback whale	16.99	0.00	35.09	51.35	2.2	17	52
Minke whale	68.98	0.01	164.88	23.09	1.4	69	165
North Atlantic right whale*	5.05	0.01	13.35	2.97	2.0	6	14
Sei whale*	1.40	0.01	3.37	5.55	1.7	2	6
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	20.16	-	2.0	0	21
Atlantic spotted dolphin	0.00	0.00	17.05	1.11	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	587.25	3.00	19.1	0	588
Common bottlenose dolphin	0.00	0.00	588.30	216.23	13.0	0	589
Common dolphin	0.00	0.00	10747.06	1813.00	24.3	0	10748
Pilot whale, long-finned	0.00	0.00	61.89	24.72	6.2	0	62
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	77.62	1.33	12.0	0	78
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.87	269.92	-	2.5	3	270
Pinnipeds (PPW hearing group)							
Gray seal	0.68	0.00	58.50	14.67	1.4	1	59
Harbor seal	0.09	0.00	11.41	2.96	1.4	1	12

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback and sei whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 14. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule A, year 4 (2031), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 1 Max Schedule A – Year 4 (2031)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	1.33	0.00	30.71	1.68	2.0	2	31
Humpback whale	0.88	0.00	18.04	3.02	2.2	1	19
Minke whale	4.14	0.00	60.48	1.36	1.4	5	61
North Atlantic right whale*	0.26	0.00	6.70	0.17	2.0	1	7
Sei whale*	0.07	0.01	1.53	0.33	1.7	1	2
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	3.22	-	2.0	0	4
Atlantic spotted dolphin	0.00	0.00	3.32	0.07	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	198.64	0.18	19.1	0	199
Common bottlenose dolphin	0.00	0.00	96.72	12.72	13.0	0	97
Common dolphin	0.00	0.00	1548.79	106.65	24.3	0	1549
Pilot whale, long-finned	0.00	0.00	17.21	1.45	6.2	0	18
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	20.39	0.08	12.0	0	21
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	0.08	86.33	-	2.5	1	87
Pinnipeds (PPW hearing group)							
Gray seal	0.01	0.00	102.64	0.86	1.4	1	103
Harbor seal	0.00	0.00	10.58	0.17	1.4	0	11

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 15. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule B year 2 (2029), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 1 Max Schedule B – Year 2 (2029)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	16.73	0.04	29.77	14.15	2.0	17	30
Humpback whale	11.27	0.01	21.54	25.37	2.2	12	26
Minke whale	45.55	0.01	104.93	11.41	1.4	46	105
North Atlantic right whale*	3.39	0.01	8.45	1.47	2.0	4	9
Sei whale*	0.99	0.01	2.40	2.74	1.7	1	3
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	12.68	-	2.0	0	13
Atlantic spotted dolphin	0.00	0.00	9.01	0.55	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	358.26	1.48	19.1	0	359
Common bottlenose dolphin	0.00	0.00	368.57	106.84	13.0	0	369
Common dolphin	0.00	0.00	6116.04	895.84	24.3	0	6117
Pilot whale, long-finned	0.00	0.00	38.25	12.21	6.2	0	39
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	45.02	0.66	12.0	0	46
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.36	161.22	-	2.5	3	162
Pinnipeds (PPW hearing group)							
Gray seal	0.61	0.00	43.45	7.25	1.4	1	44
Harbor seal	0.15	0.00	8.21	1.46	1.4	1	9

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 16. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 1 using installation Schedule B year 3 (2030), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 1 Max Schedule B – Year 3 (2030)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	18.24	0.05	55.16	15.50	2.0	19	56
Humpback whale	12.89	0.01	51.30	27.79	2.2	13	52
Minke whale	55.82	0.01	220.49	12.50	1.4	56	221
North Atlantic right whale*	3.95	0.01	19.33	1.61	2.0	4	20
Sei whale*	1.24	0.01	6.87	3.00	1.7	2	7
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	15.54	-	2.0	0	16
Atlantic spotted dolphin	0.00	0.00	17.48	0.60	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	698.98	1.63	19.1	0	699
Common bottlenose dolphin	0.00	0.00	491.98	117.02	13.0	0	492
Common dolphin	0.00	0.00	8061.40	981.16	24.3	0	8062
Pilot whale, long-finned	0.00	0.00	58.29	13.38	6.2	0	59
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	63.52	0.72	12.0	0	64
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.52	251.02	-	2.5	3	252
Pinnipeds (PPW hearing group)							
Gray seal	0.68	0.00	421.35	7.94	1.4	1	422
Harbor seal	0.17	0.00	29.72	1.60	1.4	1	30

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

6.3.4.3 Project 2

Table 17. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule A year 3 (2030), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data	Mean	Total Estimated Take Project 2 Max Schedule A – Year 3 (2030)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior	Based Estimate[a]	Group Size[b]	Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	0.44	0.01	1.01	1.68	2.0	1	2
Humpback whale	0.89	0.00	2.18	3.02	2.2	1	4
Minke whale	1.84	0.00	5.18	1.36	1.4	2	6
North Atlantic right whale*	0.31	0.00	0.94	0.17	2.0	1	2
Sei whale*	0.14	0.01	0.36	0.33	1.7	1	2
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	0.80	-	2.0	0	2
Atlantic spotted dolphin	0.00	0.00	1.85	0.07	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	38.51	0.18	19.1	0	39
Common bottlenose dolphin	0.00	0.00	25.31	12.72	13.0	0	26
Common dolphin	0.00	0.00	605.49	106.65	24.3	0	606
Pilot whale, long-finned	0.00	0.00	3.06	1.45	6.2	0	7
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	3.08	0.08	12.0	0	12
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	0.14	16.64	-	2.5	1	17
Pinnipeds (PPW hearing group)							
Gray seal	0.08	0.00	13.72	0.86	1.4	1	14
Harbor seal	0.01	0.00	2.51	0.17	1.4	1	3

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for fin, North Atlantic right, sei, and sperm whales; Atlantic spotted and Risso's dolphins; and long- and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 18. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule A year 4 (2031), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule A – Year 4 (2031)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	27.17	0.01	234.28	26.62	2.0	28	235
Humpback whale	18.86	0.00	138.39	47.72	2.2	19	139
Minke whale	82.43	0.02	454.74	21.46	1.4	83	455
North Atlantic right whale*	5.51	0.01	54.06	2.76	2.0	6	55
Sei whale*	1.52	0.01	12.95	5.16	1.7	2	13
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	67.30	-	2.0	0	68
Atlantic spotted dolphin	0.00	0.00	171.90	1.03	24.0	0	172
Atlantic white-sided dolphin	0.00	0.00	1793.83	2.79	19.1	0	1794
Common bottlenose dolphin	0.00	0.00	1616.59	200.96	13.0	0	1617
Common dolphin	0.00	0.00	32125.13	1685.03	24.3	0	32126
Pilot whale, long-finned	0.00	0.00	216.84	22.97	6.2	0	217
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	449.67	1.24	12.0	0	450
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	3.19	882.37	-	2.5	4	883
Pinnipeds (PPW hearing group)							
Gray seal	0.90	0.00	1040.50	13.63	1.4	1	1041
Harbor seal	0.07	0.00	95.73	2.75	1.4	1	96

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 19. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule B year 4 (2031), with 10 dB sound attenuation.

Species	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule B – Year 4 (2031)	
	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	20.69	0.02	127.51	16.51	2.0	21	128
Humpback whale	16.76	0.00	103.38	29.60	2.2	17	104
Minke whale	78.86	0.00	404.69	13.31	1.4	79	405
North Atlantic right whale*	5.50	0.02	39.04	1.71	2.0	6	40
Sei whale*	1.75	0.00	13.22	3.20	1.7	2	14
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	24.02	-	2.0	0	25
Atlantic spotted dolphin	0.00	0.00	30.58	0.64	24.0	0	31
Atlantic white-sided dolphin	0.00	0.00	1354.56	1.73	19.1	0	1355
Common bottlenose dolphin	0.00	0.00	868.55	124.65	13.0	0	869
Common dolphin	0.00	0.00	14191.02	1045.14	24.3	0	14192
Pilot whale, long-finned	0.00	0.00	109.60	14.25	6.2	0	110
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	129.02	0.77	12.0	0	130
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.63	492.95	-	2.5	3	493
Pinnipeds (PPW hearing group)							
Gray seal	1.48	0.00	1028.00	8.46	1.4	2	1028
Harbor seal	0.14	0.00	63.69	1.70	1.4	1	64

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on average group size for short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

Table 20. Marine mammal exposure and take estimates incidental to pile driving during foundation installation for Project 2 using installation Schedule B year 5 (2032), with 10 dB sound attenuation.

	Modeled Exposure Estimate			PSO Data Based Estimate[a]	Mean Group Size[b]	Total Estimated Take Project 2 Max Schedule B – Year 5 (2032)	
Species	PTS SEL_{cum}	PTS SPL_{pk}	Behavior			Level A Take	Level B Take[c]
Mysticetes (LF hearing group)							
Fin whale*	20.89	0.00	19.99	14.83	2.0	21	20
Humpback whale	17.00	0.00	20.30	26.58	2.2	17	27
Minke whale	87.54	0.00	132.75	11.95	1.4	88	133
North Atlantic right whale*	5.67	0.01	7.69	1.54	2.0	6	8
Sei whale*	1.56	0.00	3.46	2.87	1.7	2	4
Odontocetes (HF hearing group)							
Sperm whale*	0.00	0.00	14.64	-	2.0	0	15
Atlantic spotted dolphin	0.00	0.00	9.26	0.58	24.0	0	24
Atlantic white-sided dolphin	0.00	0.00	491.23	1.55	19.1	0	492
Common bottlenose dolphin	0.00	0.00	555.55	111.93	13.0	0	556
Common dolphin	0.00	0.00	9407.19	938.50	24.3	0	9408
Pilot whale, long-finned	0.00	0.00	51.20	12.80	6.2	0	52
Pilot whale, short-finned	0.00	0.00	0.00	-	8.0	0	8
Risso's dolphin	0.00	0.00	63.04	0.69	12.0	0	64
Odontocetes (VHF hearing group)							
Harbor porpoise	0.00	2.32	198.61	-	2.5	3	199
Pinnipeds (PPW hearing group)							
Gray seal	1.48	0.00	15.13	7.59	1.4	2	16
Harbor seal	0.07	0.00	6.75	1.53	1.4	1	7

* Indicates species listed as endangered under the US Endangered Species Act.

[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of piling days for this schedule and year.

[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**. The take estimate assumes one average group size per year of foundation installation.

[c] The Level B take estimate is based on PSO data for humpback whales and based on average group size for Atlantic spotted dolphins and short-finned pilot whales. For all other species, the Level B take estimate is based on the modeled exposure estimate.

UXO Detonation

6.5.2.2 Modeled Acoustic Ranges

Table 21. Acoustic ranges ($R_{95\%}$) to PTS (Level A) and TTS (Level B) onset frequency-weighted SEL thresholds for detonation of one E12 UXO at the six sites, with 10 dB attenuation, used in exposure estimates. For comparison, the PTS and TTS onset peak ranges are also shown.

		Range (m) to PTS Onset - SEL						Range (m) to PTS Onset - L_{pk}	
	Level A	Lease Area		CT OECC		MA OECC		Level A	All
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4	Threshold	Sites
Low-frequency cetacean	183	3,950	4,250	5,550	4,210	4,260	3,980	222	617
High-frequency cetacean	193	246	222	373	213	314	275	230	263
Very high-frequency cetacean	159	7,490	7,670	10,200	7,460	8,380	7,800	202	5405
Phocid pinniped in water	183	2,050	2,050	3,080	1,970	2,280	2,190	223	554
		Range (m) to TTS Onset - SEL						Range (m) to TTS Onset - L_{pk}	
	Level B	Lease Area		CT OECC		MA OECC		Level A	All
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4	Threshold	Sites
Low-frequency cetacean	168	19,000	21,000	34,100	21,200	21,800	18,700	216	1178
High-frequency cetacean	178	2,580	2,520	3,860	2,560	2,920	2,750	224	498
Very high-frequency cetacean	144	28,800	29,600	36,300	28,300	29,800	29,400	196	10438
Phocid pinniped in water	168	12,700	13,600	18,700	13,800	14,900	13,200	217	1057

Table 22. Areas (km^2) ensonified to PTS (Level A) and TTS (Level B) onset (frequency-weighted SEL) levels from detonation of one E12 UXO at the six sites, with 10 dB attenuation, used in exposure estimates.

		Area (km^2) Ensonified to Level A Threshold					
	Level A	Lease Area		CT OECC		MA OECC	
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4
Low-frequency cetacean	183	51.60	58.50	59.80	58.50	54.80	52.00
High-frequency cetacean	193	0.20	0.163	0.454	0.151	0.328	0.25
Very high-frequency cetacean	159	179.00	184.00	230.00	184.00	211.00	197.00
Phocid pinniped in water	183	13.90	13.80	18.80	12.80	16.90	15.80
		Area (km^2) Ensonified to Level B Threshold					
	Level B	Lease Area		CT OECC		MA OECC	
Hearing Group	Threshold	S1	S2	S5	S6	S3	S4
Low-frequency cetacean	168	997.00	1,140.00	1,500.00	1,210.00	951.00	957.00
High-frequency cetacean	178	22.00	21.10	35.60	21.70	28.10	24.90
Very high-frequency cetacean	144	2,280.00	2,260.00	2,490.00	2,090.00	1,860.00	2,070.00
Phocid pinniped in water	168	480.00	510.00	624.00	555.00	546.00	514.00

6.5.2 Exposure and Take Estimates Incidental to UXO Detonations

Table 23. Level A (PTS onset, SEL threshold) marine mammal exposure estimates incidental to UXO detonation, for a single detonation at each of the modeled sites, using the highest density month and assuming 10 dB of sound attenuation.

	Level A (PTS SEL) Exposure Estimate					
	Lease Area		CT OECC		MA OECC	
Species	S1	S2	S5	S6	S3	S4
Mysticetes (LF hearing group)						
Fin whale*	0.27	0.31	0.53	0.51	0.22	0.21
Humpback whale	0.23	0.26	0.38	0.37	0.16	0.15
Minke whale	0.77	0.87	1.33	1.31	0.94	0.90
North Atlantic right whale*	0.09	0.11	0.03	0.03	0.06	0.06
Sei whale*	0.05	0.05	0.07	0.07	0.03	0.03
Odontocetes (HF hearing group)						
Sperm whale*	0.01	0.01	0.01	0.01	0.01	0.01
Atlantic spotted dolphin	0.01	0.01	0.01	0.01	0.01	0.01
Atlantic white-sided dolphin	0.01	0.01	0.03	0.01	0.01	0.01
Common bottlenose dolphin	0.01	0.01	0.02	0.01	0.01	0.01
Common dolphin	0.09	0.07	0.31	0.10	0.06	0.05
Pilot whale, long-finned	0.01	0.01	0.01	0.01	0.01	0.01
Pilot whale, short-finned	0.01	0.01	0.01	0.01	0.01	0.01
Risso's dolphin	0.01	0.01	0.01	0.01	0.01	0.01
Odontocetes (VHF hearing group)						
Harbor porpoise	4.34	4.46	1.52	1.22	6.39	5.96
Pinnipeds (PPW hearing group)						
Gray seal	1.18	1.18	4.28	2.91	9.60	8.97
Harbor seal	0.24	0.24	0.86	0.59	1.94	1.81

* Indicates species listed as endangered under the US Endangered Species Act.

Table 24. Level B (TTS onset, SEL threshold) marine mammal exposure estimates incidental to UXO detonation, for a single detonation at each of the modeled sites, using the highest density month and assuming 10 dB of sound attenuation.

	Level B (TTS SEL) Exposure Estimate					
	Lease Area		CT OECC		MA OECC	
Species	**S1**	**S2**	**S5**	**S6**	**S3**	**S4**
Mysticetes (LF hearing group)						
Fin whale*	5.31	6.07	13.18	10.63	3.80	3.83
Humpback whale	4.43	5.06	9.56	7.71	2.76	2.78
Minke whale	14.91	17.05	33.47	27.00	16.39	16.49
North Atlantic right whale*	1.82	2.08	0.74	0.60	1.13	1.13
Sei whale*	0.92	1.05	1.83	1.48	0.47	0.48
Odontocetes (HF hearing group)						
Sperm whale*	0.04	0.04	0.07	0.05	0.03	0.02
Atlantic spotted dolphin	0.33	0.32	0.89	0.54	0.09	0.08
Atlantic white-sided dolphin	1.19	1.14	2.71	1.65	0.71	0.63
Common bottlenose dolphin	0.73	0.70	1.80	1.09	0.65	0.57
Common dolphin	9.85	9.45	24.49	14.93	5.29	4.69
Pilot whale, long-finned	0.09	0.09	0.19	0.12	0.04	0.03
Pilot whale, short-finned	0.02	0.02	0.05	0.03	0.01	0.01
Risso’s dolphin	0.41	0.40	0.73	0.44	0.03	0.03
Odontocetes (VHF hearing group)						
Harbor porpoise	55.27	54.79	16.49	13.84	56.29	62.64
Pinnipeds (PPW hearing group)						
Gray seal	40.88	43.43	142.08	126.37	310.04	291.87
Harbor seal	8.25	8.77	28.69	25.52	62.60	58.94

* Indicates species listed as endangered under the US Endangered Species Act.

Table 25. Maximum Level A and Level B exposure and take estimates[c] incidental to UXO detonation in the Lease Area, Connecticut OECC, and Massachusetts OECC, with 10 dB sound attenuation. Assumes two detonations in the Lease Area and four detonations in each of the OECCs.

	Maximum Density-based Exposure Estimate						PSO Data-based Estimate[a]		Mean Group Size[b]	Maximum Take Estimate					
	Lease Area		CT OECC		MA OECC					Lease Area		CT OECC		MA OECC	
Species	Level A	Level B	Level A	Level B	Level A	Level B	LA	OECCs		Level A	Level B	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)															
Fin whale*	0.58	11.38	2.08	47.62	0.86	15.26	0.67	1.35	2.0	1	12	3	48	1	16
Humpback whale	0.49	9.49	1.50	34.54	0.62	11.08	1.21	2.42	2.2	1	10	2	35	1	12
Minke whale	1.64	31.96	5.28	120.94	3.68	65.76	0.54	1.09	1.4	2	32	6	121	4	66
North Atlantic right whale*	0.20	3.90	0.12	2.68	0.24	4.52	0.07	0.14	2.0	1	4	1	3	1	5
Sei whale*	0.10	1.97	0.28	6.62	0.12	1.90	0.13	0.26	1.7	1	2	1	7	1	2
Odontocetes (HF hearing group)															
Sperm whale*	0.02	0.08	0.04	0.24	0.04	0.10	-	-	2.0	1	2	1	2	1	2
Atlantic spotted dolphin	0.02	0.65	0.04	2.86	0.04	0.34	0.03	0.05	24.0	1	24	1	24	1	24
Atlantic white-sided dolphin	0.02	2.33	0.08	8.72	0.04	2.68	0.07	0.14	19.1	1	20	1	20	1	20
Common bottlenose dolphin	0.02	1.43	0.06	5.78	0.04	2.44	5.09	10.18	13.0	1	14	1	14	1	14
Common dolphin	0.16	19.30	0.82	78.84	0.22	19.96	42.66	85.32	24.3	1	43	1	86	1	86
Pilot whale, long-finned	0.02	0.18	0.04	0.62	0.04	0.14	0.58	1.16	6.2	1	7	1	7	1	7
Pilot whale, short-finned	0.02	0.04	0.04	0.16	0.04	0.04	-	-	8.0	1	8	1	8	1	8
Risso's dolphin	0.02	0.81	0.04	2.34	0.04	0.12	0.03	0.06	12.0	1	12	1	12	1	12
Odontocetes (VHF hearing group)															
Harbor porpoise	8.80	110.06	5.48	60.66	24.70	237.86	-	-	2.5	9	111	6	61	25	238
Pinnipeds (PPW hearing group)															
Gray seal	2.36	84.31	14.38	536.90	37.14	1203.82	0.35	0.69	1.4	3	85	15	537	38	1204
Harbor seal	0.48	17.02	2.90	108.42	7.50	243.08	0.07	0.14	1.4	1	18	3	109	8	244

* Indicates species listed as endangered under the US Endangered Species Act.
[a] PSO data based estimate is the daily PSO sighting rate from the last column of **Error! Reference source not found.** multiplied by the number of detonations in the Lease Area and OECCs.
[b] Mean group size is the maximum for each species of the PSO and AMAPPS mean group sizes shown in **Error! Reference source not found.**.
c Level B take estimates for all mid-frequency odontocetes are based on average group size, except for common dolphins, which are based on PSO data. All other Level B take estimates (mysticetes, high-frequency odontocetes, and pinnipeds) are density based. The one exception to this is for sei whales for which the Level B take estimate for the Massachusetts OECC is based on group size.

6.5.3.1 Vineyard Northeast Full Buildout

Table 26. Marine mammal exposure and maximum take estimates incidental to UXO detonation for the full buildout of Vineyard Northeast for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A				Schedule B									
	Year 2 (2029)				Year 1 (2028)				Year 3 (2030)				Both Years	
	Exposures		Takes[a]		Exposures		Takes[a]		Exposures		Takes[a]		Total Takes[b]	
Species	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)														
Fin whale*	3.52	74.26	4	75	2.35	52.93	3	53	1.17	21.33	2	22	5	75
Humpback whale	2.61	55.11	3	56	1.73	38.97	2	39	0.88	16.14	1	17	3	56
Minke whale	10.60	218.66	11	219	6.05	135.85	7	136	4.55	82.81	5	83	12	219
North Atlantic right whale*	0.56	11.10	1	12	0.21	4.50	1	5	0.35	6.60	1	7	2	12
Sei whale*	0.50	10.49	1	11	0.33	7.54	1	8	0.17	2.95	1	3	2	11
Odontocetes (HF hearing group)														
Sperm whale*	0.10	0.42	1	2	0.05	0.28	1	2	0.05	0.14	1	2	2	4
Atlantic spotted dolphin	0.10	3.85	1	24	0.05	3.19	1	24	0.05	0.66	1	24	2	48
Atlantic white-sided dolphin	0.14	13.73	1	20	0.09	9.91	1	20	0.05	3.82	1	20	2	40
Common bottlenose dolphin	0.12	9.65	1	26	0.07	6.51	1	14	0.05	3.14	1	14	2	28
Common dolphin	1.20	118.10	2	214	0.91	88.69	1	107	0.29	29.41	1	107	2	214
Pilot whale, long-finned	0.10	0.94	1	7	0.05	0.71	1	7	0.05	0.23	1	7	2	14
Pilot whale, short-finned	0.10	0.24	1	8	0.05	0.18	1	8	0.05	0.06	1	8	2	16
Risso's dolphin	0.10	3.27	1	12	0.05	2.75	1	12	0.05	0.52	1	12	2	24
Odontocetes (VHF hearing group)														
Harbor porpoise	38.98	408.58	39	409	9.82	115.93	10	116	29.16	292.65	30	293	40	409
Pinnipeds (PPW hearing group)														
Gray seal	53.88	1825.03	54	1826	15.56	577.78	16	578	38.32	1247.25	39	1248	55	1826
Harbor seal	10.88	368.52	11	369	3.14	116.67	4	117	7.74	251.85	8	252	12	369

[a] Level B takes are the maximum of the modeled exposure estimate, PSO data-based estimate (last column of **Error! Reference source not found.** multiplied by the number of detonations), and mean group size (**Error! Reference source not found.**) multiplied by number of detonations, and therefore may be greater than the Level B exposures shown in this table.

[b] The sum of the take for the two years under Schedule B is greater than the total take under Schedule A because exposure estimates for the different areas were rounded in each year prior to being summed. This method was deemed most appropriate because the exposures occur in different years and are therefore independent events. Under Schedule A, all take occurs during a single year, so the exposure estimates are rounded only once. Under Schedule B, the table shows exposure estimates rounded up for each of the two years separately, so summing these yearly take estimates after each has been rounded up results in higher total take estimates for this schedule.

* Indicates species listed as endangered under the US Endangered Species Act.

6.5.3.2 Project 1

Table 27. Maximum marine mammal take estimates incidental to UXO detonation for Project 1 for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A		Schedule B	
	Year 2 (2029)		Year 1 (2028)	
Species	**Level A**	**Level B**	**Level A**	**Level B**
Mysticetes (LF hearing group)				
Fin whale*	3	53	3	53
Humpback whale	2	39	2	39
Minke whale	7	136	7	136
North Atlantic right whale*	1	5	1	5
Sei whale*	1	8	1	8
Odontocetes (HF hearing group)				
Sperm whale*	1	2	1	2
Atlantic spotted dolphin	1	24	1	24
Atlantic white-sided dolphin	1	20	1	20
Common bottlenose dolphin	1	14	1	14
Common dolphin	1	107	1	107
Pilot whale, long-finned	1	7	1	7
Pilot whale, short-finned	1	8	1	8
Risso's dolphin	1	12	1	12
Odontocetes (VHF hearing group)				
Harbor porpoise	10	116	10	116
Pinnipeds (PPW hearing group)				
Gray seal	16	578	16	578
Harbor seal	4	117	4	117

* Indicates species listed as endangered under the US Endangered Species Act.

6.5.3.3 Project 2

Table 28. Maximum marine mammal take estimates incidental to UXO detonation for Project 2 for the two proposed construction schedules, assuming 10 dB attenuation.

	Schedule A		Schedule B	
	Year 2 (2029)		Year 3 (2030)	
Species	Level A	Level B	Level A	Level B
Mysticetes (LF hearing group)				
Fin whale*	2	22	2	22
Humpback whale	1	17	1	17
Minke whale	5	83	5	83
North Atlantic right whale*	1	7	1	7
Sei whale*	1	3	1	3
Odontocetes (HF hearing group)				
Sperm whale*	1	2	1	2
Atlantic spotted dolphin	1	24	1	24
Atlantic white-sided dolphin	1	20	1	20
Common bottlenose dolphin	1	14	1	14
Common dolphin	1	107	1	107
Pilot whale, long-finned	1	7	1	7
Pilot whale, short-finned	1	8	1	8
Risso's dolphin	1	12	1	12
Odontocetes (VHF hearing group)				
Harbor porpoise	30	293	30	293
Pinnipeds (PPW hearing group)				
Gray seal	39	1248	39	1248
Harbor seal	8	252	8	252

* Indicates species listed as endangered under the US Endangered Species Act.

6.7 Total Requested Take

6.7.1 Vineyard Northeast Full Buildout

Table 29. Summary of the requested Level A and Level B take from all activities on an annual basis for the full buildout, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	6	0.1	4	104	1.6	26	75	1.5	28	247	4.0	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	11	0.8	3	108	7.9	17	95	8.0	19	160	12.8	0	0	0.0
Minke whale	21,968	0	7	0.0	11	245	1.2	69	185	1.2	83	468	2.5	0	0	0.0
North Atlantic right whale*	340	0	3	1.0	0	18	5.2	0	17	5.0	0	61	17.9	0	0	0.0
Sei whale*	6,292	0	2	0.0	1	18	0.3	2	11	0.2	2	16	0.3	0	0	0.0
Odontocetes (HF hearing group)																
Sperm whale*	5,895	0	2	0.0	1	6	0.1	0	23	0.4	0	71	1.2	0	0	0.0
Atlantic spotted dolphin	31,506	0	18	0.1	1	66	0.2	0	48	0.2	0	208	0.7	0	0	0.0
Atlantic white-sided dolphin	93,233	0	17	0.0	1	57	0.1	0	608	0.7	0	1827	2.0	0	0	0.0
Common bottlenose dolphin	64,587	0	45	0.1	1	242	0.4	0	768	1.2	0	1699	2.6	0	0	0.0
Common dolphin	93,100	0	374	0.4	2	2017	2.2	0	12242	13.1	0	32809	35.2	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	6	0.0	1	34	0.1	0	83	0.2	0	229	0.6	0	0	0.0
Pilot whale, short-finned	18,726	0	6	0.0	1	22	0.1	0	16	0.1	0	20	0.1	0	0	0.0
Risso's dolphin	44,067	0	9	0.0	1	33	0.1	0	90	0.2	0	468	1.1	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	0	36	0.0	39	524	0.7	3	354	0.4	4	950	1.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	75	0.3	54	2954	10.8	1	1123	4.0	1	1181	4.2	0	0	0.0
Harbor seal	61,336	0	16	0.0	11	598	1.0	1	227	0	1	125	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 30. Summary of the requested Level A and Level B take from all activities on an annual basis for the full buildout, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	1	0.2	0	1	0.2	0	2	0.5	0	1	0.2	0	1	0.2
Fin whale*	6,802	3	69	1.1	17	45	0.9	19	67	1.3	18	139	2.3	21	32	0.8
Gray whale	26,960	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Humpback whale	1,396	2	67	5.0	12	52	4.6	12	68	5.7	15	126	10.1	17	48	4.6
Minke whale	21,968	7	151	0.7	46	119	0.8	50	199	1.1	70	394	2.1	88	146	1.1
North Atlantic right whale*	340	0	9	2.7	0	13	3.8	0	18	5.3	0	40	11.8	0	14	4.1
Sei whale*	6,292	1	12	0.2	1	7	0.1	2	9	0.2	2	16	0.3	2	7	0.1
Odontocetes (HF hearing group)																
Sperm whale*	5,895	1	5	0.1	0	16	0.3	1	16	0.3	0	25	0.4	0	18	0.3
Atlantic spotted dolphin	31,506	1	54	0.2	0	54	0.2	1	60	0.2	0	43	0.1	0	60	0.2
Atlantic white-sided dolphin	93,233	1	47	0.1	0	386	0.4	1	377	0.4	0	1301	1.4	0	525	0.6
Common bottlenose dolphin	64,587	1	130	0.2	0	478	0.7	1	483	0.7	0	944	1.5	0	638	1.0
Common dolphin	93,100	1	1078	1.2	0	7024	7.5	1	6944	7.5	0	14646	15.7	0	10091	10.8
False killer whale	1,298	0	8	0.6	0	8	0.6	0	16	1.2	0	8	0.6	0	8	0.6
Killer whale	unknown	0	4	unknown	0	4	unknown	0	8	unknown	0	4	unknown	0	4	unknown
Pilot whale, long-finned	39,215	1	21	0.1	0	53	0.1	1	58	0.1	0	119	0.3	0	64	0.2
Pilot whale, short-finned	18,726	1	18	0.1	0	18	0.1	1	20	0.1	0	12	0.1	0	20	0.1
Risso's dolphin	44,067	1	27	0.1	0	61	0.1	1	63	0.1	0	133	0.3	0	82	0.2
White-beaked dolphin	536,016	0	30	0.0	0	30	0.0	0	60	0.0	0	30	0.0	0	30	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	10	189	0.2	3	229	0.3	33	498	0.6	3	524	0.6	3	266	0.3
Pinnipeds (PPW hearing group)																
Gray seal	27,911	16	1004	3.7	1	459	1.6	40	2003	7.3	2	1735	6.2	2	156	0.6
Harbor seal	61,336	4	204	0	1	94	0	9	404	1	1	207	0	1	36	0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 31. Total 5-year requested Level A and Level B take from all activities for the full buildout, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	58	432	7.2
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	39	373	29.5
Minke whale	21,968	163	904	4.9
North Atlantic right whale*	340	0	99	29.1
Sei whale*	6,292	5	46	0.8
Odontocetes (HF hearing group)				
Sperm whale*	5,895	1	101	1.7
Atlantic spotted dolphin	31,506	1	340	1.1
Atlantic white-sided dolphin	93,233	1	2508	2.7
Common bottlenose dolphin	64,587	1	2753	4.3
Common dolphin	93,100	2	47441	51.0
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	351	0.9
Pilot whale, short-finned	18,726	1	64	0.3
Risso's dolphin	44,067	1	600	1.4
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	46	1863	2.2
Pinnipeds (PPW hearing group)				
Gray seal	27,911	56	5332	19.3
Harbor seal	61,336	13	965	1.6

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 32. Total 5-year requested Level A and Level B take from all activities for the full buildout, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	6	1.5
Fin whale*	6,802	78	350	6.3
Gray whale	26,960	0	5	0.0
Humpback whale	1,396	58	360	29.9
Minke whale	21,968	261	1008	5.8
North Atlantic right whale*	340	0	94	27.6
Sei whale*	6,292	8	50	0.9
Odontocetes (HF hearing group)				
Sperm whale*	5,895	2	79	1.4
Atlantic spotted dolphin	31,506	2	271	0.9
Atlantic white-sided dolphin	93,233	2	2635	2.8
Common bottlenose dolphin	64,587	2	2673	4.1
Common dolphin	93,100	2	39783	42.7
False killer whale	1,298	0	48	3.7
Killer whale	unknown	0	24	unknown
Pilot whale, long-finned	39,215	2	314	0.8
Pilot whale, short-finned	18,726	2	88	0.5
Risso's dolphin	44,067	2	366	0.8
White-beaked dolphin	536,016	0	180	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	52	1704	2.0
Pinnipeds (PPW hearing group)				
Gray seal	27,911	61	5356	19.4
Harbor seal	61,336	16	944	2

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

6.7.2 Project 1

Table 33. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 1, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	7	0.1	3	63	1.0	26	61	1.3	2	38	0.6	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	12	0.8	2	56	4.2	17	69	6.2	1	31	2.3	0	0	0.0
Minke whale	21,968	0	8	0.0	7	144	0.7	69	173	1.1	5	69	0.3	0	0	0.0
North Atlantic right whale*	340	0	4	1.0	0	6	1.8	0	15	4.4	0	11	3.1	0	0	0.0
Sei whale*	6,292	0	2	0.0	1	10	0.2	2	8	0.2	1	4	0.1	0	0	0.0
Odontocetes (HF hearing group)																
Sperm whale*	5,895	0	2	0.0	1	3	0.1	0	22	0.4	0	6	0.1	0	0	0.0
Atlantic spotted dolphin	31,506	0	24	0.1	1	36	0.1	0	36	0.1	0	48	0.2	0	0	0.0
Atlantic white-sided dolphin	93,233	0	20	0.0	1	30	0.0	0	598	0.6	0	219	0.2	0	0	0.0
Common bottlenose dolphin	64,587	0	46	0.1	1	86	0.1	0	661	1.0	0	143	0.2	0	0	0.0
Common dolphin	93,100	0	385	0.4	1	705	0.8	0	11346	12.2	0	1934	2.1	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	7	0.0	1	16	0.0	0	71	0.2	0	25	0.1	0	0	0.0
Pilot whale, short-finned	18,726	0	8	0.0	1	12	0.1	0	12	0.1	0	16	0.1	0	0	0.0
Risso's dolphin	44,067	0	12	0.0	1	18	0.0	0	84	0.2	0	33	0.1	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	0	40	0.0	10	153	0.2	3	307	0.4	1	127	0.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	78	0.3	16	929	3.4	1	410	1.5	1	181	0.7	0	0	0.0
Harbor seal	61,336	0	16	0	4	188	0	1	83	0	0	27	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 34. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 1, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028) Level A Take	Year 1 (2028) Level B Take	Year 1 (2028) % Abund. Take	Year 2 (2029) Level A Take	Year 2 (2029) Level B Take	Year 2 (2029) % Abund. Take	Year 3 (2030) Level A Take	Year 3 (2030) Level B Take	Year 3 (2030) % Abund. Take	Year 4 (2031) Level A Take	Year 4 (2031) Level B Take	Year 4 (2031) % Abund. Take	Year 5 (2032) Level A Take	Year 5 (2032) Level B Take	Year 5 (2032) % Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0	0	0	0.0
Fin whale*	6,802	3	69	1.1	17	40	0.8	19	56	1.1	0	0	0.0	0	7	0.1
Gray whale	26,960	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0	0	0	0.0
Humpback whale	1,396	2	68	5.0	12	43	3.9	13	52	4.7	0	0	0.0	0	12	0.8
Minke whale	21,968	7	152	0.7	46	113	0.7	56	221	1.3	0	0	0.0	0	8	0.0
North Atlantic right whale*	340	0	10	2.8	0	10	2.9	0	20	5.9	0	0	0.0	0	4	1.0
Sei whale*	6,292	1	12	0.2	1	5	0.1	2	7	0.1	0	0	0.0	0	2	0.0
Odontocetes (HF hearing group)																
Sperm whale*	5,895	1	5	0.1	0	14	0.2	0	16	0.3	0	0	0.0	0	2	0.0
Atlantic spotted dolphin	31,506	1	60	0.2	0	36	0.1	0	24	0.1	0	0	0.0	0	24	0.1
Atlantic white-sided dolphin	93,233	1	50	0.1	0	369	0.4	0	699	0.7	0	0	0.0	0	20	0.0
Common bottlenose dolphin	64,587	1	132	0.2	0	441	0.7	0	492	0.8	0	0	0.0	0	46	0.1
Common dolphin	93,100	1	1089	1.2	0	6715	7.2	0	8062	8.7	0	0	0.0	0	385	0.4
False killer whale	1,298	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0	0	0	0.0
Killer whale	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	unknown	0	0	unknown
Pilot whale, long-finned	39,215	1	23	0.1	0	48	0.1	0	59	0.2	0	0	0.0	0	7	0.0
Pilot whale, short-finned	18,726	1	20	0.1	0	12	0.1	0	8	0.0	0	0	0.0	0	8	0.0
Risso's dolphin	44,067	1	30	0.1	0	52	0.1	0	64	0.1	0	0	0.0	0	12	0.0
White-beaked dolphin	536,016	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0	0	0	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	10	192	0.2	3	199	0.2	3	252	0.3	0	0	0.0	0	40	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	16	1007	3.7	1	395	1.4	1	422	1.5	0	0	0.0	0	78	0.3
Harbor seal	61,336	4	204	0	1	80	0	1	30	0	0	0	0.0	0	16	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 35. Total 5-year requested Level A and Level B take from all activities for Project 1, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	31	167	2.9
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	20	167	13.4
Minke whale	21,968	81	393	2.2
North Atlantic right whale*	340	0	35	10.3
Sei whale*	6,292	4	24	0.4
Odontocetes (HF hearing group)				
Sperm whale*	5,895	1	33	0.6
Atlantic spotted dolphin	31,506	1	144	0.5
Atlantic white-sided dolphin	93,233	1	867	0.9
Common bottlenose dolphin	64,587	1	935	1.4
Common dolphin	93,100	1	14368	15.4
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	118	0.3
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	1	147	0.3
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	14	625	0.7
Pinnipeds (PPW hearing group)				
Gray seal	27,911	18	1597	5.8
Harbor seal	61,336	5	314	0.5

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 36. Total 5-year requested Level A and Level B take from all activities for Project 1, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a] Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	39	171	3.1
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	27	174	14.4
Minke whale	21,968	109	493	2.7
North Atlantic right whale*	340	0	43	12.6
Sei whale*	6,292	4	26	0.5
Odontocetes (HF hearing group)				
Sperm whale*	5,895	1	37	0.6
Atlantic spotted dolphin	31,506	1	144	0.5
Atlantic white-sided dolphin	93,233	1	1138	1.2
Common bottlenose dolphin	64,587	1	1110	1.7
Common dolphin	93,100	1	16250	17.5
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	136	0.3
Pilot whale, short-finned	18,726	1	48	0.3
Risso’s dolphin	44,067	1	158	0.4
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	16	682	0.8
Pinnipeds (PPW hearing group)				
Gray seal	27,911	18	1901	6.9
Harbor seal	61,336	6	330	1

* Indicates species listed as endangered under the US Endangered Species Act.
[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

6.7.3 Project 2

Table 37. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 2, Schedule A.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2	0	0	0.0
Fin whale*	6,802	0	0	0.0	2	42	0.6	1	17	0.3	28	241	3.9	0	0	0.0
Gray whale	26,960	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	0	0.0
Humpback whale	1,396	0	0	0.0	1	52	3.8	1	30	2.2	19	149	12.0	0	0	0.0
Minke whale	21,968	0	0	0.0	5	101	0.5	2	18	0.1	83	462	2.5	0	0	0.0
North Atlantic right whale*	340	0	0	0.0	0	12	3.5	0	4	1.2	0	58	17.1	0	0	0.0
Sei whale*	6,292	0	0	0.0	1	8	0.1	1	5	0.1	2	15	0.3	0	0	0.0
Odontocetes (HF hearing group)																
Sperm whale*	5,895	0	0	0.0	1	5	0.1	0	3	0.1	0	70	1.2	0	0	0.0
Atlantic spotted dolphin	31,506	0	0	0.0	1	60	0.2	0	36	0.1	0	196	0.6	0	0	0.0
Atlantic white-sided dolphin	93,233	0	0	0.0	1	50	0.1	0	49	0.1	0	1814	1.9	0	0	0.0
Common bottlenose dolphin	64,587	0	0	0.0	1	160	0.2	0	133	0.2	0	1656	2.6	0	0	0.0
Common dolphin	93,100	0	0	0.0	1	1324	1.4	0	1502	1.6	0	32447	34.9	0	0	0.0
False killer whale	1,298	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6	0	0	0.0
Killer whale	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown	0	0	0.0
Pilot whale, long-finned	39,215	0	0	0.0	1	27	0.1	0	20	0.0	0	224	0.6	0	0	0.0
Pilot whale, short-finned	18,726	0	0	0.0	1	20	0.1	0	12	0.1	0	16	0.1	0	0	0.0
Risso's dolphin	44,067	0	0	0.0	1	30	0.1	0	18	0.0	0	462	1.0	0	0	0.0
White-beaked dolphin	536,016	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0	0	0	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	0	0	0.0	30	112	0.2	1	65	0.1	4	917	1.1	0	0	0.0
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	0	0.0	39	820	3.1	1	727	2.6	1	1109	4.0	0	0	0.0
Harbor seal	61,336	0	0	0	8	166	0	1	147	0	1	110	0	0	0	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 38. Summary of the requested Level A and Level B take from all activities on an annual basis for Project 2, Schedule B.

Species	NMFS Stock Abundance[a]	Year 1 (2028)			Year 2 (2029)			Year 3 (2030)			Year 4 (2031)			Year 5 (2032)		
		Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take	Level A Take	Level B Take	% Abund. Take
Mysticetes (LF hearing group)																
Blue whale*	402	0	0	0.0	0	0	0.0	0	1	0.2	0	1	0.2	0	1	0.2
Fin whale*	6,802	0	0	0.0	0	6	0.1	2	37	0.6	21	143	2.4	21	26	0.7
Gray whale	26,960	0	0	0.0	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Humpback whale	1,396	0	0	0.0	0	10	0.7	1	43	3.1	17	130	10.5	17	37	3.8
Minke whale	21,968	0	0	0.0	0	7	0.0	5	95	0.5	79	417	2.3	88	140	1.0
North Atlantic right whale*	340	0	0	0.0	0	3	0.9	0	9	2.6	0	42	12.4	6	11	5.0
Sei whale*	6,292	0	0	0.0	0	2	0.0	1	6	0.1	2	17	0.3	2	6	0.1
Odontocetes (HF hearing group)																
Sperm whale*	5,895	0	0	0.0	0	2	0.0	1	3	0.1	0	26	0.4	0	17	0.3
Atlantic spotted dolphin	31,506	0	0	0.0	0	24	0.1	1	36	0.1	0	43	0.1	0	48	0.2
Atlantic white-sided dolphin	93,233	0	0	0.0	0	20	0.0	1	30	0.0	0	1365	1.5	0	512	0.5
Common bottlenose dolphin	64,587	0	0	0.0	0	39	0.1	1	121	0.2	0	976	1.5	0	595	0.9
Common dolphin	93,100	0	0	0.0	0	321	0.3	1	1003	1.1	0	15088	16.2	0	9729	10.4
False killer whale	1,298	0	0	0.0	0	0	0.0	0	8	0.6	0	8	0.6	0	8	0.6
Killer whale	unknown	0	0	unknown	0	0	unknown	0	4	unknown	0	4	unknown	0	4	unknown
Pilot whale, long-finned	39,215	0	0	0.0	0	7	0.0	1	20	0.1	0	123	0.3	0	59	0.2
Pilot whale, short-finned	18,726	0	0	0.0	0	8	0.0	1	12	0.1	0	12	0.1	0	16	0.1
Risso's dolphin	44,067	0	0	0.0	0	12	0.0	1	18	0.0	0	136	0.3	0	76	0.2
White-beaked dolphin	536,016	0	0	0.0	0	0	0.0	0	30	0.0	0	30	0.0	0	30	0.0
Odontocetes (VHF hearing group)																
Harbor porpoise	85,765	0	0	0.0	0	34	0.0	30	341	0.4	3	541	0.6	3	233	0.3
Pinnipeds (PPW hearing group)																
Gray seal	27,911	0	0	0.0	0	68	0.2	39	1961	7.2	2	1741	6.2	2	84	0.3
Harbor seal	61,336	0	0	0.0	0	14	0	8	396	1	1	208	0.3	1	21	0.0

* Indicates species listed as endangered under the US Endangered Species Act.

Table 39. Total 5-year requested Level A and Level B take from all activities for Project 2, Schedule A.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	31	299	4.9
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	21	230	18.0
Minke whale	21,968	90	580	3.0
North Atlantic right whale*	340	0	74	21.8
Sei whale*	6,292	4	28	0.5
Odontocetes (HF hearing group)				
Sperm whale*	5,895	1	78	1.3
Atlantic spotted dolphin	31,506	1	292	0.9
Atlantic white-sided dolphin	93,233	1	1913	2.1
Common bottlenose dolphin	64,587	1	1948	3.0
Common dolphin	93,100	1	35272	37.9
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	270	0.7
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	1	510	1.2
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	35	1093	1.3
Pinnipeds (PPW hearing group)				
Gray seal	27,911	41	2655	9.7
Harbor seal	61,336	10	423	0.7

* Indicates species listed as endangered under the US Endangered Species Act.
[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Table 40. Total 5-year requested Level A and Level B take from all activities for Project 2, Schedule B.

Species	NMFS Stock Abundance[a]	5-Year Total[a]		
		Level A Take	Level B Take	Percent of NMFS Stock Abundance
Mysticetes (LF hearing group)				
Blue whale*	402	0	3	0.7
Fin whale*	6,802	44	210	3.7
Gray whale	26,960	0	3	0.0
Humpback whale	1,396	35	218	18.1
Minke whale	21,968	172	657	3.8
North Atlantic right whale*	340	6	65	20.9
Sei whale*	6,292	5	31	0.6
Odontocetes (HF hearing group)				
Sperm whale*	5,895	1	48	0.8
Atlantic spotted dolphin	31,506	1	151	0.5
Atlantic white-sided dolphin	93,233	1	1927	2.1
Common bottlenose dolphin	64,587	1	1730	2.7
Common dolphin	93,100	1	26140	28.1
False killer whale	1,298	0	24	1.8
Killer whale	unknown	0	12	unknown
Pilot whale, long-finned	39,215	1	208	0.5
Pilot whale, short-finned	18,726	1	48	0.3
Risso's dolphin	44,067	1	242	0.6
White-beaked dolphin	536,016	0	90	0.0
Odontocetes (VHF hearing group)				
Harbor porpoise	85,765	36	1148	1.4
Pinnipeds (PPW hearing group)				
Gray seal	27,911	43	3853	14.0
Harbor seal	61,336	10	639	1

* Indicates species listed as endangered under the US Endangered Species Act.

[a] 5-year totals may not always be exactly equal to the sum of the individual 5 years due to rounding.

Updated Mitigation Zone Sizes

11.6.2 Foundation Installation

Table 41. Exclusion zones for impact and vibratory pile driving.[1]

Species/Species Group	Visual		Acoustic[2]	Visual and Acoustic Clearance Duration
	Clearance Zone (CZ)	Shutdown Zone (SZ)	PAM CZ & SZ	
North Atlantic right whale (NARW)	**Any distance**	**Any distance**	10 km	**June 1 – October 14**: Until 30 minutes (min) of visual and acoustic monitoring confirms no further detection of NARW(s) **October 15 – December 31**: Outside of the NARW Enhanced Mitigation Area, if three (3) or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan, if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.

Species/Species Group	Visual		Acoustic[2]	Visual and Acoustic Clearance Duration
	Clearance Zone (CZ)	Shutdown Zone (SZ)	PAM CZ & SZ	
Unidentified large whale	Any unidentified large whale sighted at any distance that cannot be identified to species as not a NARW is treated as a NARW for purposes of clearance and delay	Any unidentified large whale sighted at any distance that cannot be identified to species as not a NARW is treated as a NARW for purposes of a shutdown in foundation installation	10 km	See above
Other mysticetes (humpback, fin, minke, sei, gray, & blue whales)	One monopile/day: 5.13 km; Two monopiles/day or one jacket: 5.36 km	One monopile/day: 5.13 km; Two monopiles/day or one jacket: 5.36 km	One monopile/day: 5.13 km; Two monopiles/day or one jacket: 5.36 km	30 minutes
Sperm whales	160 m	160 m	160 m	30 minutes
Risso's dolphins, pilot whales, killer whales, and false killer whales	160 m	160 m	160 m	30 minutes
Other delphinids (e.g., Atlantic white-sided dolphins, Atlantic spotted dolphins, common dolphins, common bottlenose dolphins, white-beaked dolphins)	160 m	160 m	160 m	15 minutes
Pinnipeds	One monopile/day: 700 m; Two monopiles/day: 800 m Pin pile: 1.4 km	One monopile/day: 700 m; Two monopiles/day: 800 m Pin pile: 1.4 km	One monopile: 700 m; Two monopiles/day: 800 m Pin pile: 1.4 km	15 minutes
Harbor porpoise	160 m	160 m	160 m	15 minutes

[1]Clearance and shutdown zones correspond to the Level A harassment threshold, except for the NARW and unidentified large whale, or are slightly larger. These zones may increase to accommodate the size of the far-field NAS (i.e., big bubble curtain); if that is the case, the Level A harassment zones for high-frequency cetaceans (HFCs) and mid-frequency cetaceans (MFCs) are typically smaller than the radial distance to the edge of the furthest far-field NAS (i.e., big bubble curtain).

[2]The PAM monitoring zone for all species/species groups is 10 km.

Table 42. Exclusion zones for drilling during foundation installation.[1]

Species/Species Group	Visual Clearance Zone (CZ)	Visual Shutdown Zone (SZ)	PAM CZ & SZ[2]	Visual and Acoustic Clearance Duration
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	Any distance	Any distance	10 km	**June 1 – October 14**: Until 30 minutes (min) of visual and acoustic monitoring confirms no further detection of NARW(s) **October 15 – December 31**: Outside of the NARW Enhanced Mitigation Area, if three (3) or more NARWs are visually observed at any distance, no foundation installation will occur until the following day. Consistent with the Enhanced Mitigation Plan, if one or two NARW(s) are visually detected at any distance from the foundation location or acoustically detected within the 10 km PAM clearance zone, foundation installation will be postponed and will not commence until the following day, unless a follow-up aerial or vessel-based survey and near real-time PAM confirms NARW(s) have not been detected again upon completion of the survey, as determined by the Lead PSO.
Low-frequency hearing group	190 m	190 m	190 m	30 minutes
High-frequency hearing group – large odontocetes (sperm whales, Risso's dolphins, pilot whales, killer whales, false killer whales)	20 m	20 m	20 m	30 minutes
High-frequency hearing group – small odontocetes (other dolphins)	20 m	20 m	20 m	15 minutes

Very high-frequency hearing group (harbor porpoise)	80 m	80 m	80 m	15 minutes
Pinnipeds (seals)	130 m	130 m	130 m	15 minutes

[1]Clearance and shutdown zones correspond to the Level A harassment threshold, except for the NARW and unidentified large whale, or are slightly larger.

[2]The PAM monitoring zone for all species/species groups is 10 km.

11.6.3 UXO Detonation

Table 43. Exclusion zones for UXO detonations.[1,2]

Species/Species Group	Visual Clearance Zone	PAM Clearance Zone[3]
North Atlantic right whale (NARW) (and any unidentified large whale that cannot be confirmed as not a NARW)	Any distance	Any distance
Low-frequency hearing group (other than NARW)	5,600 m	5,600 m
High-frequency hearing group – large (sperm whale, Risso's dolphins, pilot whales, killer whales, false killer whales) and small (other dolphins) odontocetes	400 m	400 m
Very high-frequency hearing group (harbor porpoise)	10,200 m	10,200 m
Pinnipeds (seals)	3,100 m	3,100 m

[1]Clearance zones correspond to the Level A harassment threshold (assuming 10 dB attenuation), except for the NARW and unidentified large whale, or are slightly larger. Because UXO detonations are instantaneous, no shutdown is possible; therefore, there are no shutdown zones for UXO detonations.

[2]UXO detonation may commence when the marine mammal(s) has voluntarily left the specific clearance zones and have been visually and acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species.

[3]The PAM monitoring zone is 10 km for all species/species groups.

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Attachment

Vineyard Northeast Underwater Acoustic and Exposure Modeling Addendum