# Petition for Incidental Take Regulations for the Construction and Operations of the SouthCoast Wind Project

Submitted To:

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

Submitted By:

**SouthCoast Wind Energy LLC**

SOUTHCOAST WIND

Prepared By:

**LGL Ecological Research Associates, Inc.**

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# 1 Description of Specified Activity

SouthCoast Wind Energy LLC (SouthCoast Wind, formerly Mayflower Wind Energy LLC), a 50/50 joint venture between Shell New Energies US LLC (Shell New Energies) and OW North America LLC (Ocean Winds), proposes an offshore wind renewable energy generation project (the Project) located in federal waters off the southern coast of Massachusetts in the Outer Continental Shelf (OCS) Lease Area OCS-A 0521 (Lease Area). The purpose of the proposed Project is to provide clean, renewable wind energy to the northeast United States, including Massachusetts. SouthCoast Wind will support generation reliability in Massachusetts and in the New England region, while meeting statutory needs for renewable/clean energy. The SouthCoast Wind Project also supports the federal need for grid reliability, as set forth in the Federal Power Act in Section 215 (Congressional Research Services, 2020).

The Project is defined in the SouthCoast Wind Construction and Operations Plan (SouthCoast Wind 2023) using a Project Design Envelope (PDE) approach. SouthCoast Wind uses a PDE to describe a reasonable range of potential design options for wind turbine generators (WTGs), offshore substation platforms (OSPs), substructures, inter-array and export cable corridors (ECCs), onshore substation and converter station sites, onshore interconnection routes, and associated facilities. This approach has been informed by BOEM's *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM, 2018). The Lease Area is located off the southern coast of Massachusetts, approximately 26 nm (48 km) south of Martha's Vineyard and 20 nm (37 km) south of Nantucket. At its closest point, the Lease Area is 39 nm (72 km) south from the mainland at Nobska Point in Falmouth, Massachusetts. The Lease Area, shown in Figure 1, is 127,388 ac (51,552 ha). There will be up to 149 positions in the Lease Area to be occupied by WTGs and OSPs. The 149 positions will conform to a 1 nm x 1 nm grid (1.9 km x 1.9 km) layout with an east-west and north-south orientation, as agreed upon across the entire MA/RI WEA leaseholders (Equinor Wind US, Eversource Energy, SouthCoast Wind, Orsted North America, and Vineyard Wind LLC, 2019). SouthCoast Wind intends to install up to 147 WTGs and 2 OSPs connected by inter-array cables within the Lease Area. While the COP PDE includes up to 5 OSPs, SouthCoast Wind's preference and the most likely scenario is 2 HVDC OSPs, one for Project 1 and one for Project 2. The exposure modeling assumed installation of up to 16 4.5-m diameter pin piles per Project for OSP foundations (maximum of 32 pin piles over 2 years). Three possible OSP designs are being considered (as described in Section 1.1.2.2). Regardless of the OSP jacket design chosen, SouthCoast Wind does not intend to exceed the maximum installation of 16 pin piles per year as modeled. SouthCoast Wind is proposing to develop one preferred export cable corridor making landfall and interconnecting to the ISO New England Inc. (ISO-NE) grid at Brayton Point, in Somerset, Massachusetts. This preferred export cable corridor for Project 1 and Project 2 is the Brayton Point Export Cable Corridor (ECC), and the Project will also include one export cable corridor variant option which, if utilized, would make landfall and interconnect to the ISO-NE grid in the town of Falmouth, Massachusetts (the Falmouth ECC). In the event that technical, logistical, grid interconnection, or other unforeseen challenges arise during the design and engineering phase that prevent Project 2 from making interconnection at Brayton Point, Project 2 will utilize the Falmouth variant ECC and make landfall and interconnect in Falmouth, Massachusetts. Figure 1 depicts the conceptual arrangement of offshore and onshore Project components.

For the purposes of analyzing potential take of marine mammals as a result of construction and operations activities, the Project has been split into five (5) primary elements including: WTG foundations (monopile, piled jacket, and/or suction-bucket jacket), OSP foundations (monopile, piled jacket, and/or suction-bucket jacket), export cable landfall construction, high resolution geophysical (HRG) surveys, and potential unexploded ordnance (UXO) detonations.

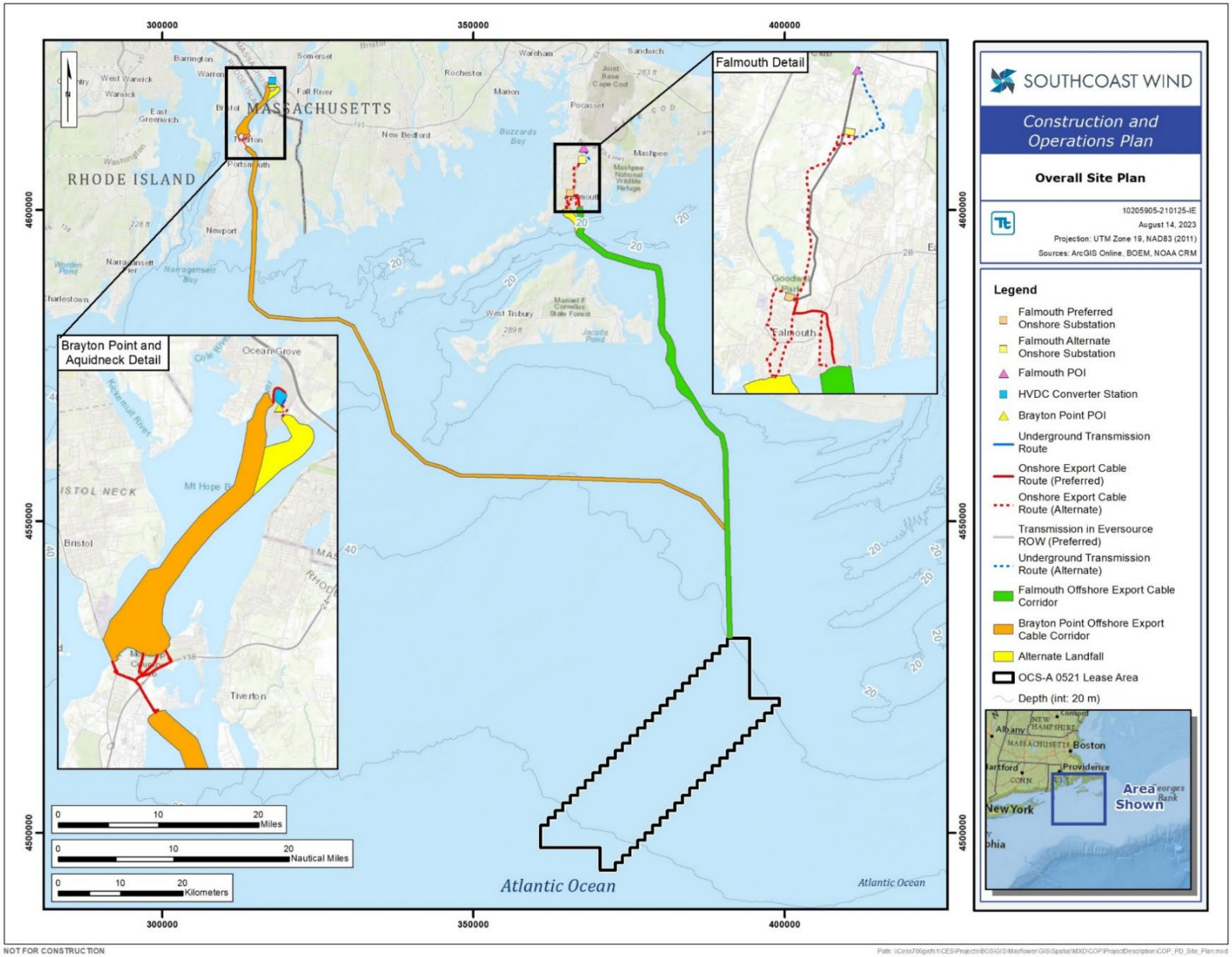

Figure 1. Location of the overall site plan for the proposed Project.

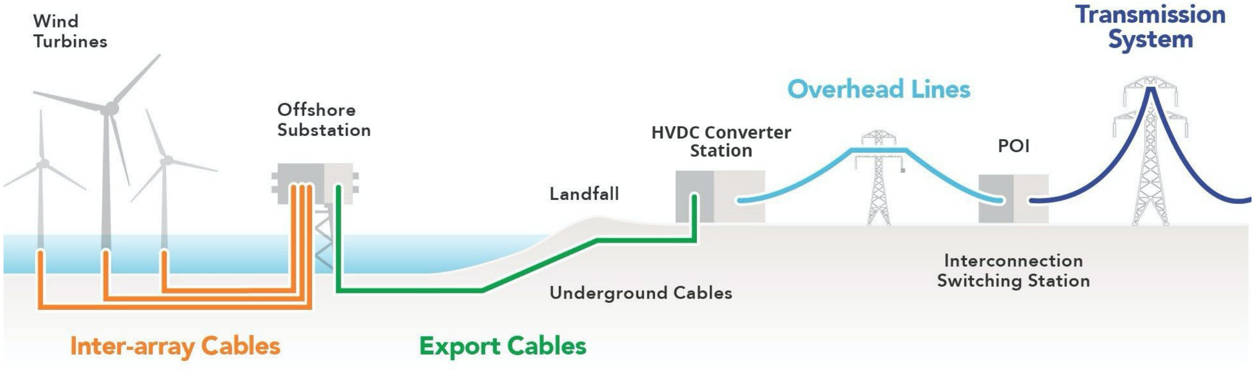

Figure 2. Onshore and offshore components (reproduced from COP Figure 1-1).

## 1.1 Offshore Project Components and Construction Activities

The primary offshore components of the Project are described in detail in Section 3.3 of Volume I of the COP and summarized below. These include components within the Lease Area (WTG and OSP foundations) and the ECCs (cable landfall installations). SouthCoast Wind has evaluated all Project construction activities for potential acoustic harassment as required under 50 CFR §216.104 governing the submission of requests for incidental taking of small numbers of marine mammals. Construction activities that may cause incidental take of marine mammals include WTG foundation installation (monopile, piled jacket, and/or suction-bucket jacket), OSP foundation installation (monopile, piled jacket, and/or suction-bucket jacket), cable landfall construction, HRG surveys, potential UXO detonation, and construction vessel activity including during inter-array cable and export cable installation. These activities are described in greater detail below.

Two different terms are used when describing materials that help to support WTGs and OSPs. A "substructure" is designed to support the WTGs and OSPs by transferring the dynamic mechanical load to the seabed. Substructures also act as an access point to the WTGs or OSPs and provide a conduit for electrical cables. A substructure is defined as the support structure which extends upwards from the seabed and connects the base of the WTG tower. A "foundation" transfers the loads acting on the structure into the seabed. For example, a jacket substructure could have four piles that impact the seabed.

### *1.1.1 Wind Turbine Generator (WTG) Substructures*

SouthCoast Wind is considering three substructure concepts: monopile, piled jacket, and suction-bucket jacket. The Project will develop and install up to two different substructure concepts for the WTGs (suction-bucket jackets are only under consideration for Project 2, for a maximum of up to 85 potential foundations) and may use a third different concept for the OSPs. Further design descriptions and anticipated parameters for each type of substructure under consideration within the PDE as well as the construction, installation, and removal methods are described below. All pile installation will include a low energy soft-start method with a gradual increase in hammering energy levels. [See Section 11 for a full discussion on the soft-start method as well as other mitigation measures proposed by SouthCoast Wind]. The soft start method is intended to provide a warning to marine mammals allowing them time to avoid approaching the construction activity before full-energy hammering commences. At a maximum, the Project expects up to two vessels working simultaneously (i.e., two piled jacket vessels or one monopile vessel and one piled jacket vessel). This will only occur for the case when one vessel is installing an OSP foundation (piled jacket vessel) and the other is installing a WTG foundation (monopile vessel or piled jacket vessel). Therefore, it is possible that two separate vessels may work simultaneously to install one WTG monopile foundation and one OSP piled jacket foundation (with four pin piles) per day or one WTG piled jacket and one OSP piled jacket foundation (each with four pin piles, for a total of eight pin piles) per day. This approach assumes 24/7 piling in addition to simultaneous piling operations for the two pile installation vessels. A remotely operated vehicle (ROV) may be used during the installation of WTG and OSP foundations. For example, an ROV may be used for a pre-clearance check of the seafloor to confirm it is free of debris.

For two substructure types, monopiles and piled jackets, impact pile driving 24-hours per day is deemed necessary based on the amount of time required to install the foundations in comparison to the time available for installation when factoring in various limitations. Under ideal conditions up to two monopile foundations could be installed in a single day (24-hour period including nighttime). At a minimum, installation of a single pile would involve a 1-hour pre-start clearance period, approximately 4 hours of piling, and 4 hours to move to the next piling location where the process would begin again. This results in an estimated 9 hours of installation time per pile under the monopile scenario, or 774 total hours for 85 WTG foundations and 1 OSP foundation in one construction season.

If pile driving were only allowed from sunrise to sunset, and no pile driving was conducted from January 1 through May 14, then approximately 2,772 hours would initially be available for pile driving (this assumes an average of 12 hours of daylight per day for 231 days). Based on prior experience it is reasonable to assume that approximately 30% of the time would be unavailable due to weather conditions, bringing the available time down to 1,940 hours and leaving a buffer of approximately 1,148 hours between the minimum time required to install the foundations and the time available. However, many other factors are anticipated to further reduce the time available for installations. For example, delays are likely due to the presence of protected species, equipment downtime and/or supply chain issues in receiving materials, commercial fishing, and other marine activity in the area. Other project operations that must occur during good weather conditions such as vessel-to-vessel transfers of crew, equipment, and materials are all likely to prohibit piling during otherwise available daylight hours. COVID-19 has introduced new challenges, increases the potential for in-season project delays, and highlights the schedule risks associated with heath concerns. Although not quantifiable at this time, the combined effect of these unforeseeable factors will further reduce the available time for piling to a point where there is an insufficient buffer between the time required for installations and the time available for installations within a single operational season should piling only be allowed during daylight hours.

To complete installation within as few years as possible during the multiple year installation campaign expected for the entire Lease Area build-out, should pile driving be limited to daylight hours, operations would need to be conducted in the currently excluded January to May 14 timeframe to create a sufficient buffer between required installation time and available installation time. The January to April timeframe is when North Atlantic right whales (NARW) are present in the region in higher numbers, meaning potential impacts to this species would increase. Alternatively, if the installations were to occur within the same May 15–December 31 period during daylight only but extend across multiple installation years, there would be an overall increase in vessel traffic, which could also increase potential impacts to NARW and other marine mammals. For these reasons, the ability to conduct nighttime impact pile driving of monopile or piled jacket foundations during time periods when the fewest number of NARW are likely to be present in the region is expected to result in the lowest overall impact of the Project on marine mammals, including NARW.

Should nighttime pile driving occur, the best currently available technology will be used to mitigate the potential impacts and result in the least practicable adverse impacts. These monitoring methods will include the use of night vision equipment, infrared/thermal imaging, and passive acoustic monitoring (PAM). Night vision equipment and infrared/thermal imaging have been shown to allow for the detection of marine mammals at night at a similar probability of detecting marine mammals during daylight visual monitoring (Verfuss et al. 2018; Guazzo et al. 2019).

#### *1.1.1.1 WTG Monopile Foundation Installation*

A conceptual example of the WTG monopile support structure is shown in Figure 3. The WTG monopile substructure is a single steel cylindrical pile that is embedded into the seabed. This type of substructure is comprised of a monopile and transition piece (TP), which may be integrated (i.e., extended monopile) or separate. The monopile is driven into the seabed and connects to the TP. The TP connects the monopile to the WTG tower and carries the secondary steel components such as access platforms, ladders, boat fenders, and landings.

Up to 147 WTG monopile foundations with a maximum diameter of 9/16 m (tapered) (52.5 ft) will be installed within the Lease Area. Monopiles would be installed using an impact pile driver with a maximum hammer energy of 6,600 kJ and/or a vibratory hammer to a maximum penetration depth of 50 m (164 ft). An oversized hammer (6,600 kJ) was modeled to presume the highest potential impact caused during impact pile driving. Therefore, if the modeling is re-run based on a smaller hammer size, updated values will be included in future submissions. Installation of each monopile will include a soft-start method as described in Section 1.1.1. Under normal conditions, after completion of the soft-start period, installation of a single monopile foundation is estimated to require approximately 4 hours of piling. It is anticipated that a maximum of two monopile foundations can be driven into the seabed per day assuming 24-hour pile driving operation (see Section 1.1.1); however, installation of 1 pile per day is expected to be more common and the installation schedule used in the exposure modeling reflects this (see Section 6.3).

SouthCoast Wind is committed to mitigation measures (e.g. soft-starts and the employment of noise attenuation systems (NAS)) to decrease the risk of auditory injury to marine mammals that may occur in the Project Area. SouthCoast Wind will employ NAS measures (e.g. bubble curtains and/or insulated piles).

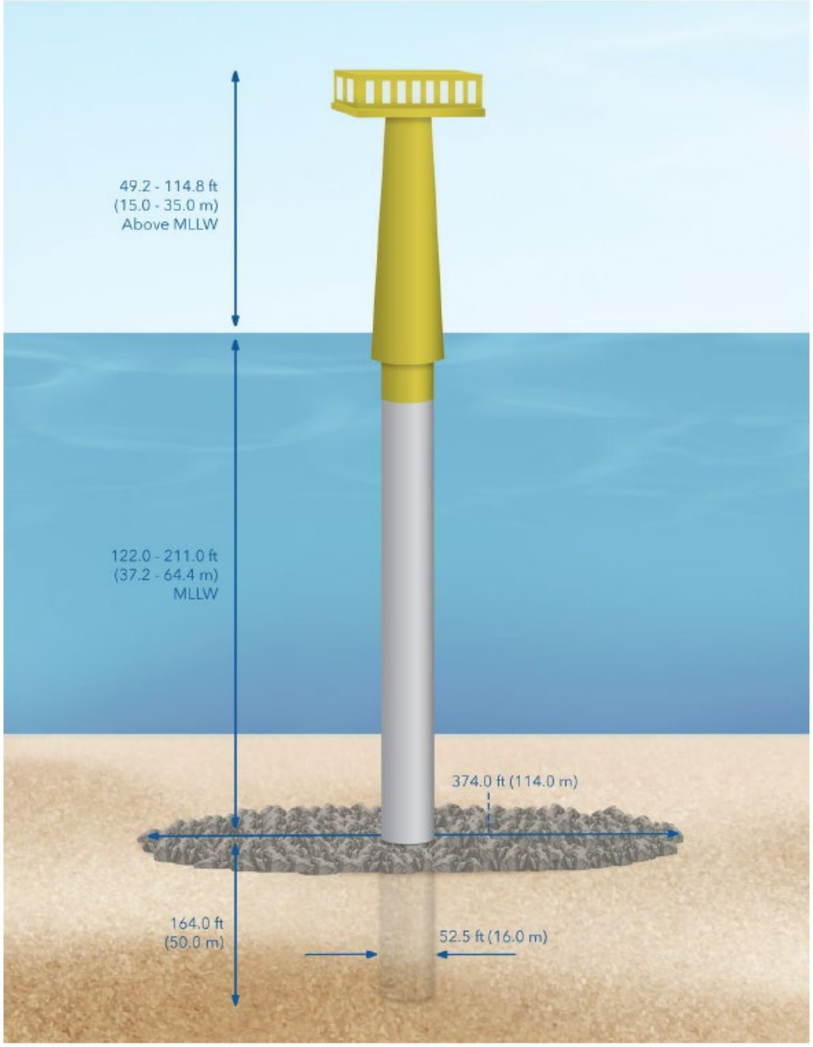

Figure 3. Schematic drawing of a WTG monopile foundation (reproduced from COP Figure 3-7).

#### *1.1.1.2 WTG Piled Jacket Foundation Installation*

Figure 4 provides a conceptual example of a WTG piled jacket foundation. Jacket structures are large lattice structures fabricated of steel tubes welded together. Unlike monopiles, there is no separate TP; the TP and ancillary components are fabricated as an integrated part of the jacket. WTG piled jackets will consist of three- or four-legged structures to support WTGs. If the jacket is piled, each leg will be anchored by one pile foundation for WTGs.

Up to 147 pin-piled jacket foundations, with four legs and one pin-pile per leg (588 total pin piles) with a maximum pile diameter of 4.5 m (14.7 ft) would be installed in the Lease Area. Installation of WTG piled jacket foundations will be performed using an impact pile driver with a maximum hammer energy of 3,500 kJ and/or a vibratory hammer to a maximum penetration depth of 70 m (229.6 ft). Installation of a single pin-piled jacket substructure is estimated to require approximately eight hours of pile driving (two hours of pile driving per pin pile, four pin piles per jacket substructure). It is anticipated that a single piled jacket substructure involving four pin piles can be driven into the seabed per day assuming 24-hour pile driving operation (see Section 1.1.1). Pile driving activity will include a soft start at the beginning of each pin pile installation as further described in Section 1.1.1.

Pin-piled jacket installation is multi-stage where the seabed is prepared and then a reusable template is placed on the seabed for accurate positioning of piles. Pin piles will be individually lowered into the template and driven to the target penetration depth using an impact hammer (Project 1) and a vibratory hammer (Project 2 only). Then the template is picked up and moved to the next location. In the subsequent stage of the installation process, a vessel installs the jacket to the piles. This could occur directly after the piling vessel completes operations, or a year later.

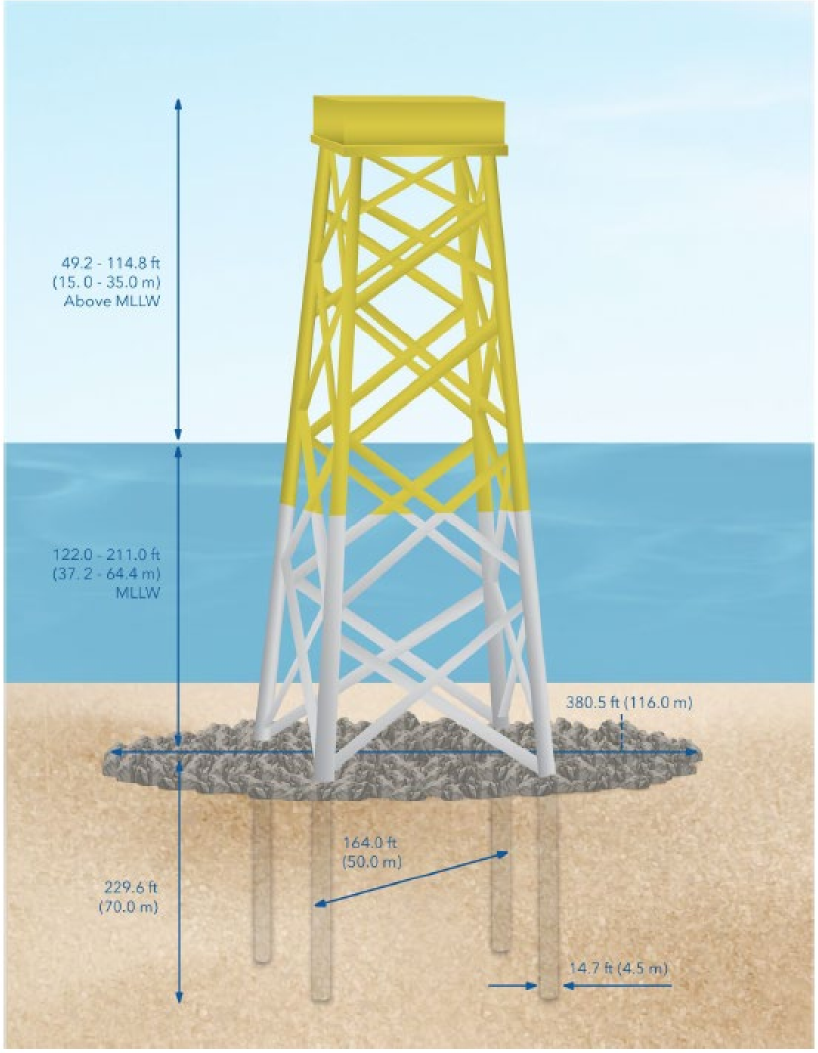

Figure 4. Example of WTG piled jacket substructure concept (reproduced from COP Figure 3-8).

#### 1.1.1.3 *WTG Suction Bucket Jacket Foundation Installation*

Figure 5 provides a conceptual example of the WTG suction bucket jacket foundation. Suction-bucket jackets have a similar steel lattice design to the piled jacket but diverge at the connection to the sea floor. These substructures use suction-buckets instead of piles to secure the structure to the seabed. Therefore, no impact driving will be used for installation of WTG suction bucket jackets.

Up to 147 suction-bucket jacket substructures including four buckets per foundation (one per leg) would be installed as described below. For suction-bucket jackets, the jacket is lowered to the seabed, the open bottom of the bucket and weight of the jacket embeds the bottom of the bucket in the seabed. To complete the installation and secure the foundation, water and air are pumped out of the bucket creating a negative pressure within the bucket which embeds the foundation buckets into the seabed. The jacket can also be leveled at this stage by varying the applied pressure. The pumps will be released from the suction buckets once the jacket reaches its designed penetration. The connection of the required suction hoses is typically completed using a remotely operated vehicle (ROV).

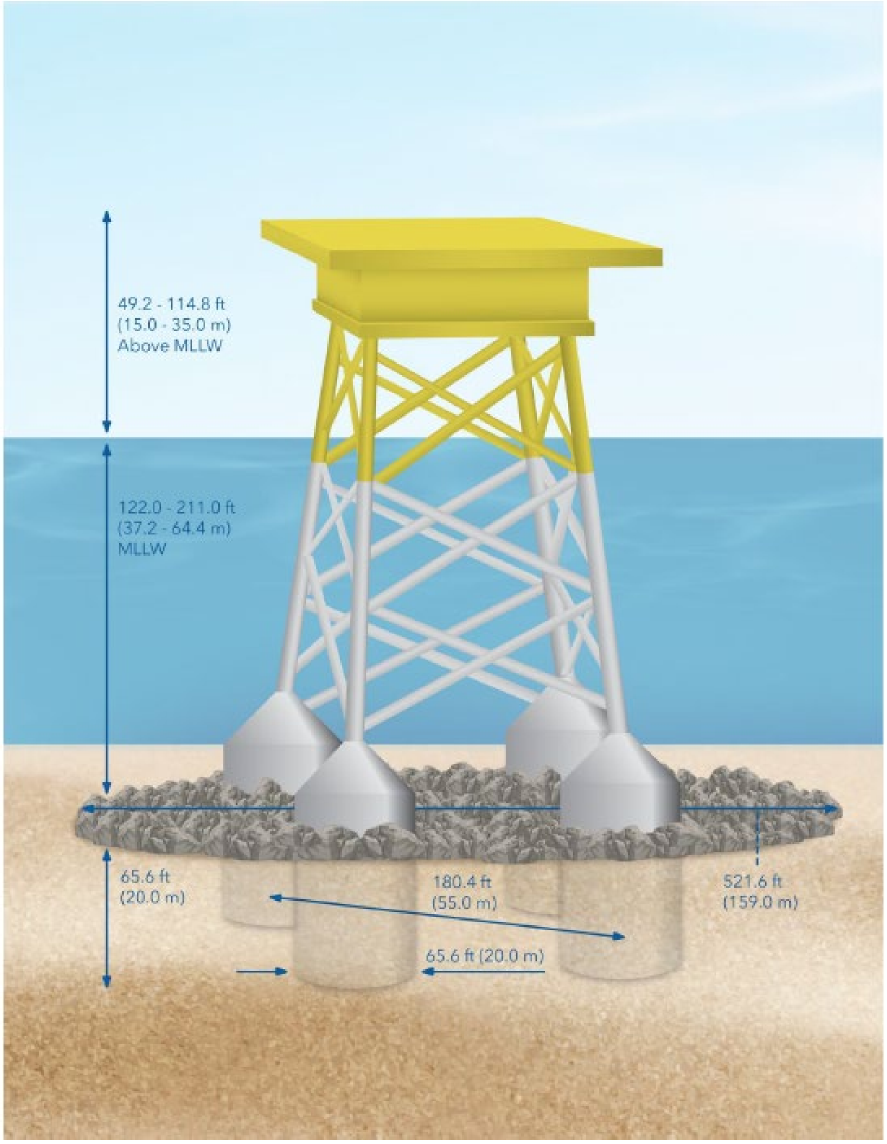

Figure 5. Example WTG suction-bucket substructure concept (reproduced from COP Figure 3-9).

### *1.1.2 Offshore Substation Platform (OSP) Substructures*

Within the COP PDE, the proposed Project includes up to five OSPs; however, SouthCoast Wind's preference and the most likely scenario includes 2 HVDC OSPs, one for Project 1 and one for Project 2. The OSPs will be located on the same 1 nm x 1 nm (1.9 km x 1.9 km) grid layout as the WTGs. Three OSP designs are under consideration, as seen below in Figures 7-9. The three OSP design options include Option A – Modular, Option B – Integrated, and Option C – Direct Current (DC) Converter. The "Modular OSP" design would sit on any one of the three types of substructure designs similar in size and weight to those described for the WTGs (see Section 1.1.1), with the topside connected to a TP. This Modular OSP design is an AC solution and will likely hold a single transformer with a single export cable. This option is a small design relative to other options and thus, has benefits related to manufacture, transportation, and installation. An example of the Modular OSP on a jacket substructure is shown in Figure 6. The modular OSP design assumes an OSP topside height ranging from 50 m (164 ft) to 73.9 m (242.5 ft).

The "Integrated OSP" design would have a jacket substructure and a larger topside than the Modular OSP. The Integrated OSP design is also an AC solution and is designed to support a high number of inter-array cable connections as well as the connection of multiple export cables. This design differs from the Modular OSP in that it is expected to contain multiple transformers and export cables integrated into a single topside. The Integrated OSP design assumes a topside height ranging from 50 m (164 ft) to 73.9 m (242.5 ft). Depending on the final weight of the topside and soil conditions, the number of legs and piles per leg may vary (see Section 1.1.2.2). The Integrated OSP's large size allows for the housing of a greater number of electrical components as compared to smaller designs (such as the Modular OSP), allowing for a smaller number of OSPs to support the proposed Project. An example of the integrated OSP design is shown in Figure 7.

SouthCoast Wind may install one or more "DC Converter OSPs." This OSP option would serve as a gathering platform for inter-array cables and then convert power from high-voltage AC to high-voltage DC or it could be connected to one or more AC gathering units (Modular or Integrated OSPs) and serve to convert power from AC to DC prior to transmission on an export cable. The DC Converter OSP would be installed on a piled jacket. A jacket substructure to support this large substation is intended to have four legs with three to four piles per leg (see Section 1.1.2.2). An example of a DC jacket OSP design is shown in Figure 8.

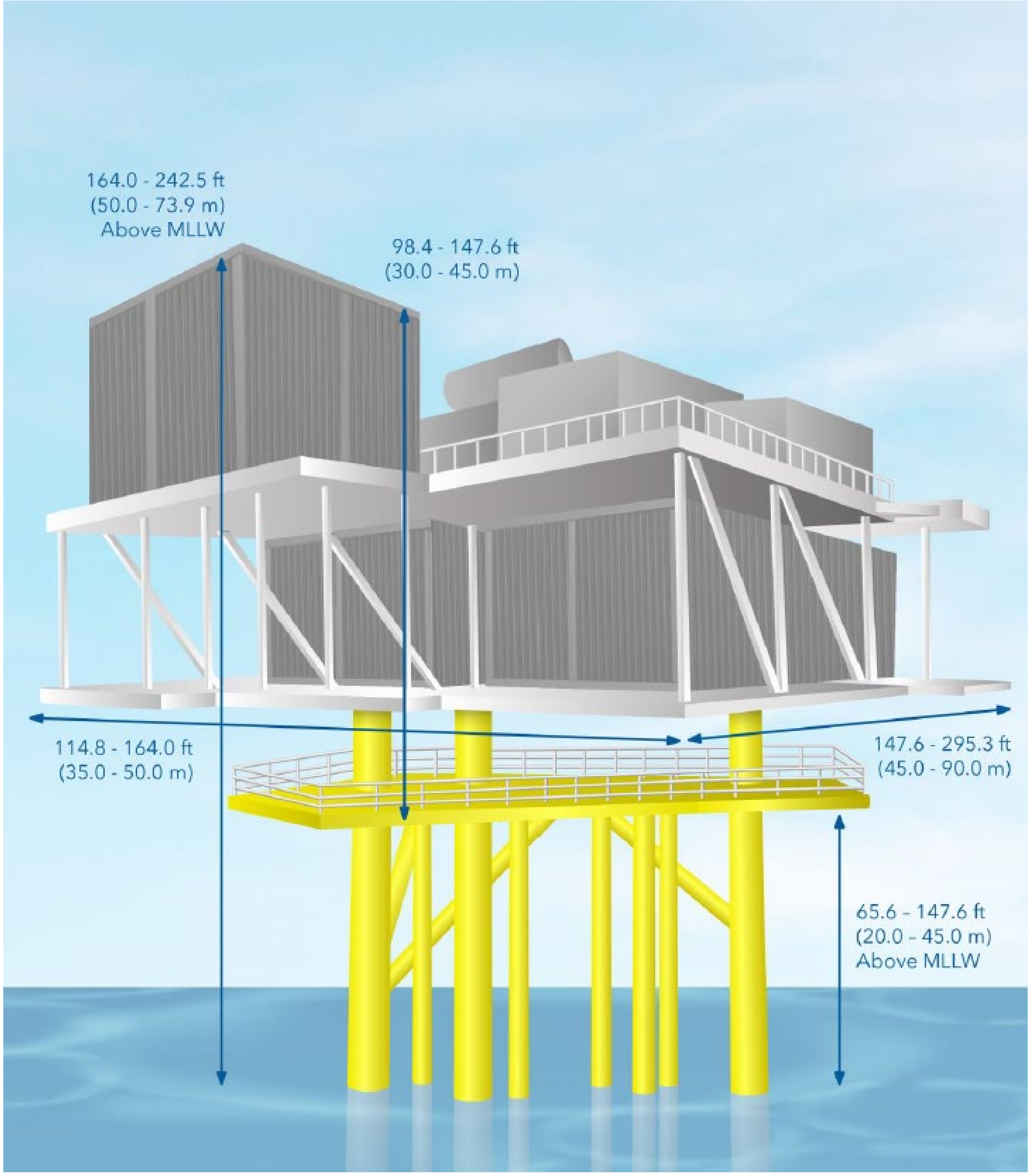

Figure 6. Indicative Modular OSP Diagram (reproduced from COP Figure 3-16).

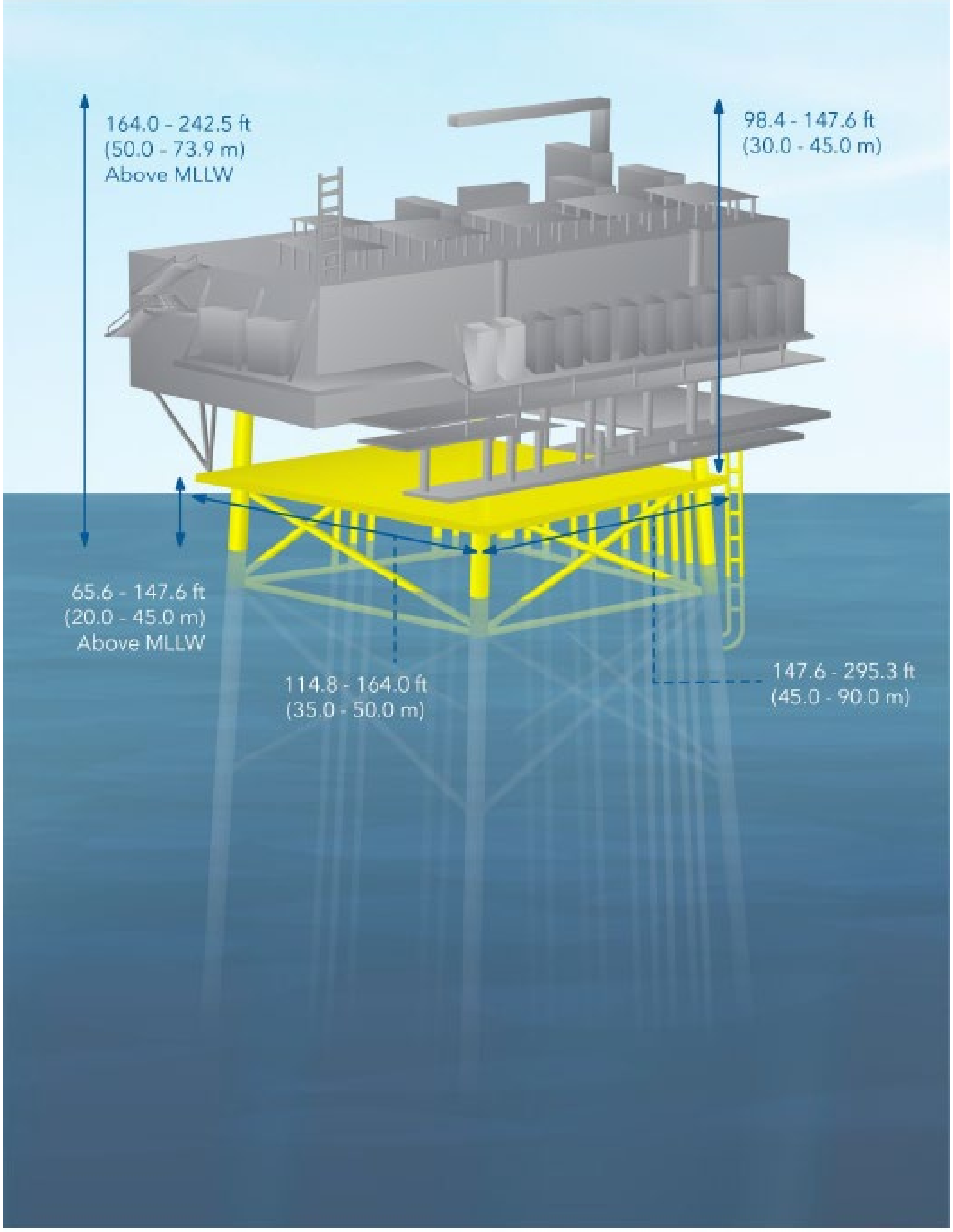

Figure 7. Integrated OSP Design (reproduced from COP Figure 3-17).

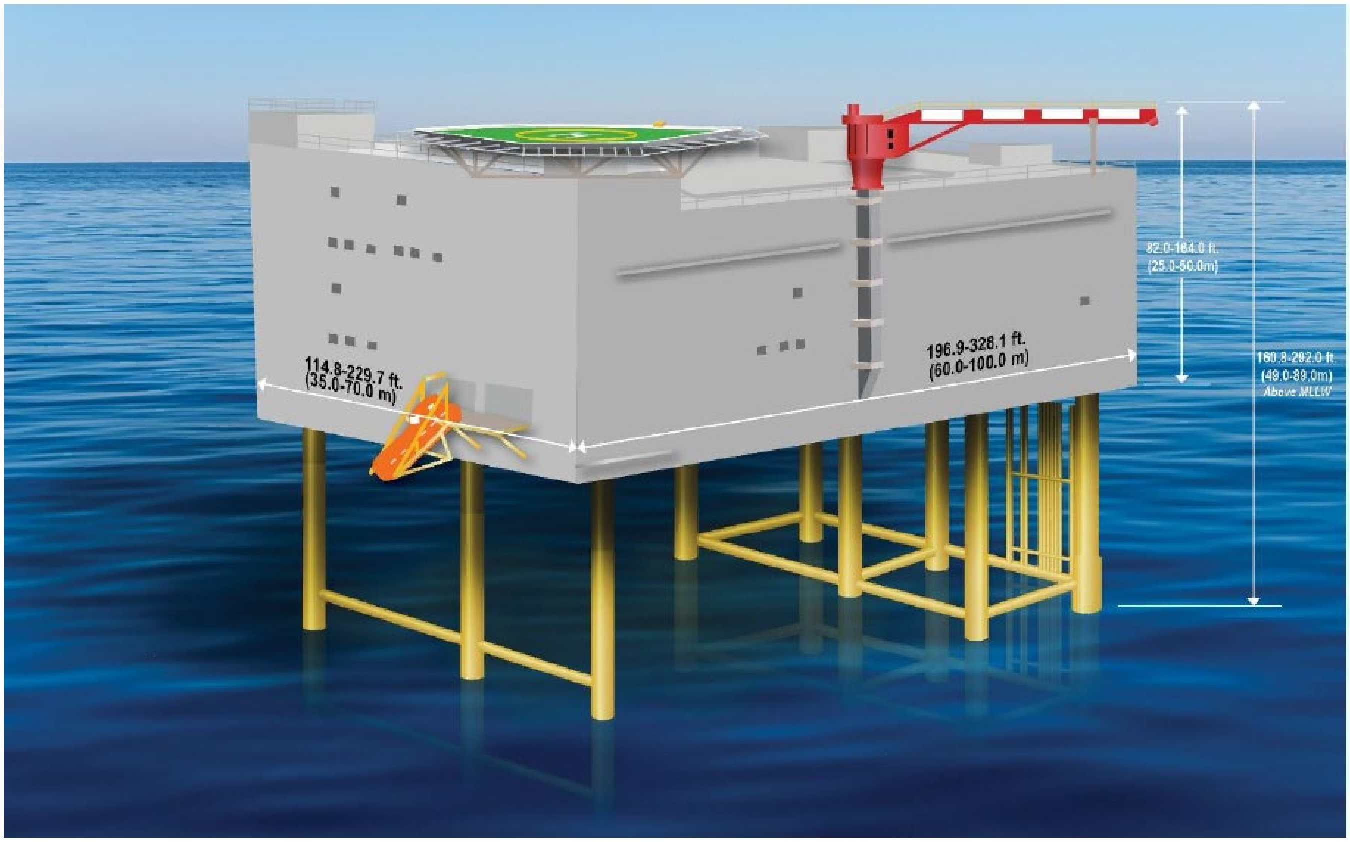

Figure 8. DC-Converter OSP diagram (with jacket) (reproduced from COP figure 3-18).

### *1.1.2.1 OSP Monopile Foundation Installation*

An OSP monopile foundation would be the same as the WTG monopile foundation described in Section 1.1.1.1 and seen in Figure 3. For an OSP, one monopile foundation with a maximum diameter of 9/16 m (tapered) (29.5/52.5 ft) would be installed to support a modular OSP (Figure 6). Monopiles would be installed using an impact pile driver with a maximum hammer energy of 6,600 kJ to a target penetration depth of 50 m (164 ft). Installation of the monopile would include a soft-start method as described in Section 1.1.1. Under normal conditions, installation of a single monopile foundation is estimated to require up to 4 hours of piling. It is anticipated that a maximum of two OSP monopile foundations could be driven per day assuming 24-hour pile driving operation.

The installation sequence for OSP foundation installation using monopiles would follow the same sequence as the monopile installation outlined above for the WTG monopile foundation installation (Section 1.1.1.1).

### *1.1.2.2 OSP Piled Jacket Foundation Installation*

OSP piled jacket foundations would be similar to the WTG piled jacket foundations described above. However, OSP piled jackets would be installed using a post-piling installation sequence. Post-piling installation is a sequence where the seabed is prepared and the jacket is set on the seafloor, then the piles are driven through the jacket legs to the designed penetration depth (depending on which OSP design is used). The piles are connected to the jacket via grouted or swaged connections or a combination of the two. A second crane vessel or another support vessel may perform grouting tasks, freeing the installation vessel to continue jacket installation at the subsequent OSP location. SouthCoast Wind intends to install two OSP piled jackets with four legs each anchored by three to four pin piles (total of up to 16 pin piles per OSP piled jacket). The number of jacket legs and pin piles would vary depending on the OSP design being supported as described below. SouthCoast Wind plans for a maximum of four OSP jacket pin piles to be installed per day, so an OSP jacket foundation requiring 16 pin piles would be installed over four days.

A Modular OSP piled jacket foundation would be the smallest and include three to four legs with one to two pin piles per leg (three to eight total pin piles per piled jacket). Pin piles would have a diameter of up to 4.5 m (14.7 ft) and would be installed using up to a 3,500-kJ hammer to a target penetration depth of 70 m (229.6 ft) below the seabed.

A jacket foundation for the Integrated OSP design would include four to six legs with one to three piles per leg (four to 12 total pin piles per jacket). The pin pile diameter would be up to 3.57 m (11.7 ft) and they would be installed using up to a 3,500-kJ hammer to a target penetration depth of 84.5 m (277.2 ft) below the seabed.

The DC-Converter OSP design with a piled jacket substructure would include four legs with three to four pin piles per leg (up to 16 total pin piles per jacket) with a pile diameter of 3.9 m (12.8 ft) installed using a 3,500-kJ hammer to a target penetration depth of 90 m (295.3 ft) below the seabed.

For all three OSP piled jacket options (modular, integrated and DC-converter), installation of a single pin pile is anticipated to take up to 2 hours of pile driving. It is anticipated that a maximum of eight pin piles could be driven into the seabed per day assuming 24-hour pile driving operation (see Section 1.1.1). Pile driving activity will include a soft start at the beginning of each pin pile installation. Pile driving noise from an OSP piled jacket foundation installation has been evaluated based on the use of a 3,500 kJ hammer as this is representative of the worst-case condition as it relates to maximum noise levels (Denes et al. 2021).

#### *1.1.2.3 OSP Suction Bucket Jacket Foundation Installation*

An OSP suction bucket jacket foundation may be used if the Integrated OSP design is carried forward. Suction-bucket jackets have a similar steel lattice design to the piled jacket but have a different connection to the seafloor. These substructures use suction-bucket foundations instead of piles to secure the structure to the seabed (Figure 5). Up to four legs with up to four buckets per leg for a total of 16 suction buckets may be part of a suction-bucket jacket installation. Delivery and placement of OSP suction bucket jacket foundations in the Lease Area would be the same as delivery of WTG suction bucket jacket foundations as described in Section 1.1.1.3.

### *1.1.3 Cable Landfall Construction*

Installation of the SouthCoast Wind Project export cable landfalls will be accomplished using horizontal directional drilling (HDD) methodology. HDD is a “trenchless” process for installing cables or pipes which enables the cables to remain buried below the beach and intertidal zone while limiting environmental impact during installation. Drilling activities would occur on land with the borehole extending under the seabed to an exit point offshore, outside of the intertidal zone. There will be up to two ECCs, both exiting the Lease Area in the north-western corner. These then split, with one making landfall at Brayton Point in Somerset, MA (Brayton Point ECC) and the other in Falmouth, MA (Falmouth ECC). The Brayton Point ECC is anticipated to contain up to six export cables, bundled where practicable, while the Falmouth ECC is anticipated to contain up to five export cables. HDD seaward exit points will be sited within the defined ECCs at the Brayton Point and Aquidneck Island landfall sites and at the Falmouth landfall site(s). The exit points will be within approximately 3,500 ft (1,069 m) of the shoreline for the Falmouth ECC landfall(s), and within approximately 1,000 ft (305 m) of the shoreline for the Brayton Point landfalls.

At the seaward exit point, construction activities may include either a temporary gravity-based structure (i.e., gravity cell or gravity-based cofferdam) and/or a dredged exit pit. Installation of both the temporary gravity-based structure and/or a dredged exit pit will not require pile driving or hammering. Additionally, a conductor pipe may be installed at the exit point to support the drilling activity. Conductor pipe installation would include pushing or jetting rather than pile driving or pipe ramming, so no pile driving is planned.

For the Falmouth landfall locations, the proposed HDD trajectory is anticipated to be approximately 0.9 mi (1.5 km) in length with a cable burial depth of up to approximately 90 ft (27.4 m) below the seabed. HDD boreholes will be separated by a distance of approximately 33 ft (10 m). Each offshore export cable is planned to require a separate HDD, with an individual bore and conduit for each export cable. The number of boreholes per site will be equal to the number of power cables installed. The Falmouth ECC will include up to four power cables with up to four boreholes at each landfall site. There may be up to one additional communications cable; however, the communications cable would be installed within the same bore as one of the power cables, likely within a separate conduit.

For the Brayton Point and Aquidneck Island intermediate landfall locations, the proposed HDD trajectory is anticipated to be approximately 0.3 mi (0.5 km) in length with a cable burial depth of up to approximately 90 ft (27.4 m) below the seabed. HDD bores will be separated by a distance of approximately 33 ft (10 m). It is anticipated the high-voltage DC cables will be unbundled at landfall. Each high-voltage DC power cable is planned to require a separate HDD, with an individual bore and conduit for each power cable. The Brayton Point and Aquidneck Island ECCs will include up to four power cables for a total of up to four boreholes at each landfall site. Each dedicated communications cable may be installed within the same bore as a power cable, likely within a separate conduit.

### *1.1.4 High Resolution Geophysical (HRG) Surveys*

HRG surveys will be conducted intermittently during construction (2 of the 5 years to be covered by the requested incidental take regulations) to identify any seabed debris and general construction support. These surveys may utilize equipment such as multi-beam echosounders, sidescan sonars, shallow penetration sub-bottom profilers (SBPs) (e.g., “Chirp”, parametric, and non-parametric SBPs), medium penetration sub-bottom profilers (e.g., sparkers), ultra-short baseline positioning equipment, and marine magnetometers.

During the construction phase an estimated 4,000 km (2,485 mi) may be surveyed within the Lease Area and 5,000 km (3,106 mi) along the ECCs in water depth ranging from 2 m (6.5 ft) to 62 m (204 ft). A maximum of four total vessels will be used concurrently for surveying. On average, 80-line km (50 mi) will be surveyed per vessel each day at approximately 5.6 km/hour (3 knots and 3.48 mi). HRG survey operations will occur on a 24-hour basis, although some vessels may only operate during daylight hours (~12-hour survey vessels). While the final survey plans will not be completed until construction contracting commences, HRG surveys are anticipated to operate at any time of year for a maximum of 112.5 active sound source days.

During the operations phase (3 of the 5 years to be covered by the requested incidental take regulations) an estimated 2,800 km (1,7398 mi) may be surveyed in the Lease Area and 3,200 km (1,988.4 mi) along the ECCs each year. Using the same estimate of 80 km (50 mi) of survey completed each day per dedicated survey vessel, approximately 75 days of survey activity would occur each year.

### *1.1.5 Unexploded Ordnance (UXO)*

A three-phase UXO desktop study is being conducted by SouthCoast Wind to assess possible UXO impact within the Lease Area and ECCs. Phase one included a desktop study on publicly available data covering the full Project Area including both the Lease Area and the ECCs. Based on the conclusions of the research and risk assessment undertaken, a varying low and moderate risk of encountering UXO on site was found. The identified risk is primarily due to the presence of Allied HE Bombs, Torpedoes, and Depth Charges. Phase two will include a further study in areas of potential interest identified during phase one and utilizes select available survey data. The final phase includes identification of any potential areas of further interest and data gaps. Additionally, phase three will present suggestions for the path forward on further reducing risk to as low as reasonably practicable (ALARP) prior to construction activities.

### *1.1.6 Construction and Operations Vessel Activity*

During offshore construction, SouthCoast Wind will utilize a number of different vessels for the transportation and installation of Project components. There are expected to be a daily average of 15 to 35 vessels depending on construction activities, with an expected maximum of 50 vessels in the Lease Area at one time. Table 1 provides a list of the vessel types, number of each vessel type, number of expected trips, anticipated years each vessel type will be in use, and potential ports to be used during construction. The offshore construction vessels will follow the vessel strike avoidance measures as described in Section 11.1.5.

Table 1. Vessel types, numbers, estimated number of trips, and potential ports to be used during construction of SouthCoast Wind.

| Vessel Type | No. of Each Type of Vessel | Supply Trips to Port from OCS or (POE in US to OCS where applicable) | Anticipated Years in Use | Potential North American Ports to be Utilized During Construction or Point of Entry (POE) into US waters |
|---|---|---|---|---|
| Anchor Handling Tug | 1-10 | 16 | 2028-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Fall River area, USA<br>Port of Salem, USA |
| Cable Lay Barge | 1-3 | 20 | 2027-2028 (Project 1); 2029-2030 (Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Fall River area, USA<br>Port of Salem, USA<br>Sparrows Point Port, USA<br>Port of Charleston, USA |
| Cable Transport and Lay Vessel | 1–5 | 88 | 2028-2029 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Fall River area, USA<br>Port of Salem, USA |

| Vessel Type | No. of Each Type of Vessel | Supply Trips to Port from OCS or (POE in US to OCS where applicable) | Anticipated Years in Use | Potential North American Ports to be Utilized During Construction or Point of Entry (POE) into US waters |
|---|---|---|---|---|
| | | | | Sparrows Point Port, USA<br>Port of Charleston, USA<br>Europe & Asia Entry point into US waters (POE) |
| Crew Transfer Vessel | 2–5 | 1608 | 2028-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Fall River area, USA |
| Dredging Vessel | 1–5 | 100 | 2026-2027 (Project 1); 2029-2030 (Project 2) | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Providence, USA<br>Canada Entry point into US waters (POE)<br>Europe & Asia Entry point into US waters (POE) |
| Heavy Lift Crane Vessel | 1–5 | 70 | 2028-2031 (Project 1 and Project 2) | Canada Entry point into US waters (POE)<br>Europe & Asia Entry point into US waters (POE)<br>Panama Canal entry point into US waters (POE) |
| Heavy Transport Vessel | 1–20 | 65 | 2027-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Davisville, USA<br>Port of Salem, USA<br>Canada Entry point into US waters (POE)<br>Europe & Asia Entry point into US waters (POE)<br>Altamira, MEX |
| Jack-up Accommodation Vessel | 1–2 | 14 | 2029-2030 (Project 1 and Project 2) | Port of Corpus Christi, USA<br>Canada Entry point into US waters (POE)<br>Europe & Asia Entry point into US waters (POE) |
| DP Accommodation Vessel | 1-2 | 16 | 2029-2030 (Project 1 and Project 2) | Port of Corpus Christi, USA<br>Canada Entry point into US waters (POE)<br>Europe & Asia Entry point into US waters (POE) |
| Multipurpose Support Vessel | 1-8 | 660 | 2027-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Fall River area, USA<br>Port of Davisville, USA<br>Port of Salem, USA |
| Scour Protection Installation Vessels | 1-2 | 40 | 2028-2030 (Project 1 and Project 2) | Canada Entry point into US waters (POE) |

| Vessel Type | No. of Each Type of Vessel | Supply Trips to Port from OCS or (POE in US to OCS where applicable) | Anticipated Years in Use | Potential North American Ports to be Utilized During Construction or Point of Entry (POE) into US waters |
|---|---|---|---|---|
| | | | | Port of Salem, USA<br>Port of New London, USA |
| Service Operations Vessel | 1-4 | 480 | 2029-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Providence, USA<br>Port of Fall River area, USA<br>Port of Davisville, USA |
| Survey Vessel | 1-5 | 26 | 2027-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USAPort of Providence, USA<br>Port of Fall River area, USA<br>Port of Salem, USA |
| Tugboat | 1-12 | 655 | 2028-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Providence, USA<br>Port of Fall River area, USA<br>Port of Davisville, USA<br>Port of Salem, USA<br>Altamira, MEX<br>Port of Corpus Christi, USA |
| Barge | 1-6 | 510 | 2028-2031 (Project 1 and Project 2) | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Providence, USA<br>Port of Fall River area, USA<br>Port of Davisville, USA<br>Port of Salem, USA<br>Altamira, MEX<br>Port of Corpus Christi, USA |

WTG and OSP substructure installation vessels may include: jack-up, dynamic positioning (DP), or semi-submersible vessels. Jack-up vessels lower their legs into the seabed for stability then lift out of the water, whereas DP vessels utilize computer-controlled positioning systems and thrusters to maintain their station. The Project is also considering the use of heavy lift vessels, barges, feeder vessels, and roll-on lift-off vessels to transport WTG components to the Lease Area for installation by the WTG installation vessel. Fabrication and installation vessels may include transport vessels, feeder vessels, jack-up vessels, and installation vessels.

During operations, SouthCoast Wind will use crew transfer vessels (CTVs) and service operations vessels (SOVs). The number of each vessel type, number of trips, and potential ports to be used during operations and maintenance are provided in Table 2. The operations vessels will follow the vessel strike avoidance measures as described in Section 11.1.5.

Table 2. Vessel types, numbers, estimated number of trips, and potential ports to be used during operations of SouthCoast Wind.

| Vessel Type | No. of Each Type of Vessel | Supply Trips to Port from OCS or (POE in US to OCS where applicable) | Potential North American Ports to be Utilized During Operations |
|---|---|---|---|
| Maintenance Crew/Crew Transfer Vessels (CTVs) | 1–4 | 15,015 | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Fall River area, USA |
| Service Operations Vessel (SOV) | 1 | 1638 | Port of New Bedford, USA<br>Port of New London, USA<br>Port of Providence, USA<br>Port of Fall River area, USA<br>Port of Davisville, USA |

## 1.2 Activities Resulting in Potential Take of Marine Mammals

Based on the planned construction activities summarized above, pile driving during WTG and OSP monopile foundation installation and/or WTG and OSP piled jacket foundation installation, HRG surveys and potential UXO detonation may cause incidental take of marine mammals.

Impact pile driving during the Project could result in incidental take of marine mammals through the introduction of sound into the water column. When piles are driven with impact hammers, they deform, sending a bulge travelling down the pile that radiates sound into the surrounding air, water, and seabed. Thus, noise generated by impact pile driving consists of regular, pulsed sounds of short duration. This sound may be received as a direct transmission from the source to biological receivers such as marine mammals, sea turtles, and fish; through the water, 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 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.

Vibratory pile driving during the Project could result in incidental take of marine mammals. Vibratory hammering is accomplished by applying rapidly alternating (~250 Hz) forces to the pile that create non-impulsive sounds. Vibratory pile driving produces non-impulsive and continuous sounds with lower peak sound pressure levels ($\mathrm{SPL}_{\mathrm{pk}}$) (Buehler et al. 2015; Guan and Miner 2020). Although the overall sound levels associated with vibratory hammering are typically less than impact hammering, the lower disturbance threshold (120 dB re 1 µPa $\mathrm{SPL}_{\mathrm{rms}}$) for continuous sounds means that vibratory pile driving activity will often result in a larger area ensonified above that threshold and therefore a larger number of potential Level B takes.

HRG survey equipment have the potential to be audible to marine mammals (MacGillivray et al. 2014) including those with operating frequencies below 180 kHz. Some of the HRG equipment with operation frequencies below 180 kHz may cause take. HRG survey sources with operating frequencies >180 kHz are outside the hearing range of marine mammals and will not cause take. The operating frequencies of representative HRG sound sources are shown in Table 3. Despite generating sounds in frequencies below 180 kHz, certain characteristics of the signals produced by some HRG survey equipment mean that they are unlikely to cause takes of marine mammals (see Section 1.3). However, the frequency range and signal characteristics of sparkers, boomers, and non-parametric SBPs may cause behavioral take and are therefore assessed further in Section 6.

Table 3. Representative HRG survey equipment and operating frequencies.

| Equipment Type | System | Operating Frequency |
|---|---|---|
| Sparker | Geomarine Geo-Spark<br>400 tips, up to 800 J | 0.01 – 1.9 kHz |
| | Applied Acoustics Dura-Spark UHD<br>400 tips, up to 800 J | 0.01 – 1.9 kHz |
| Boomer | Applied Acoustics S-boom | 0.01 – 5 kHz |
| Non-Parametric Sub-bottom Profiler | EdgeTech 3100 with<br>SB 2-16 towfish | 2 – 16 kHz |
| | Edgetech DW-106 | 1 – 10 kHz |
| | Teledyne Benthos Chirp III | 2 – 7 kHz |
| | Knudson Pinger SBP | 15 kHz |

Underwater detonations create broadband impulsive sounds with a high peak pressures and rapid rise times (Richardson et al. 1995). UXOs with more net explosive weight will produce higher peak pressures. For example, UXOs with 2.3 kg (5 lb) may produce peak pressures of ~255 dB at 10 m (33 ft), while UXOs of 454 kg (1,000 lb) may produce peak pressures of over 270 dB at 10 m (33 ft). At close ranges, these sounds have the potential to cause non-auditory injury to marine mammals and at longer ranges, auditory injury and behavioral disturbance are possible. The unique nature of sounds and pressure into the water column from underwater detonations, including the high peak pressure levels and the fact that they are typically just a single impulsive event, means threshold criteria for UXO detonations are different than for other anthropogenic sounds. Further descriptions of those criteria are provided in Section 6.2.

To estimate the potential take of marine mammals from these activities and sound sources, acoustic propagation modeling was conducted to determine distances to relevant acoustic impact thresholds. For WTG and OSP foundation installations, animal movement modeling was also performed to better understand the potential for incidental take of marine mammals. The modeling results are summarized in Section 6.1 along with the estimates of take. Appendix A contains a detailed description of the propagation and animal movement modeling, including modeling procedures and assumptions.

## 1.3 Activities Not Resulting in Potential Take of Marine Mammals

Routine vessel activities such as transits between ports and the Lease Area and ECCs or between worksites within those areas are not anticipated to cause take of marine mammals. Project activities such as placement of scour protection, seabed preparation, 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. SouthCoast Wind will use horizontal directional drilling (HDD) for the sea-to-shore transition of export cables between the ocean and the land. HDD will all occur on land and there is no plan to build a cofferdam or other structure requiring pile driving at the location where the HDD exits the seafloor offshore and thus no take is expected from this activity. As part of various construction related activities, including cable laying and construction material delivery, dynamic positioning (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, further reducing the potential for startle or flight responses on the part of marine mammals. Monitoring of past projects that entailed use of DP thrusters has shown a lack of observed marine mammal responses as a result of exposure to sound from DP thrusters (NMFS 2018). As DP thrusters are not expected to result in take of marine mammals, these activities are not analyzed further in this document.

HRG survey sources with operating frequencies above 180 kHz, including most multi-beam echosounders and side scan sonars, are not anticipated to cause take since these frequencies are not audible to marine mammals. As noted in Section 1.2, HRG equipment with operating frequencies below 180 kHz may cause take. However, some HRG survey equipment with operating frequencies below 180 kHz are also not anticipated to cause take. Parametric SBPs produce very narrowly focused beams of sound (0.5–3°) at relatively high frequencies that attenuate rapidly in water and are therefore not expected to cause takes of marine mammals (NMFS 2021d). Similarly, USBL systems used for high-accuracy positioning of survey equipment and vessels have previously been shown to produce extremely short distances to threshold levels under typical operating conditions so are also not expected to result in take (NMFS 2021d).

Seabed preparations will be the first offshore activity to occur during the construction phase of the Project. This may involve scour protection installation, although scour protection may be placed either prior to or after WTG and OSP installation, depending on the requirements of each substructure type. Scour protection is the placement of materials on the seafloor around the substructures to prevent the development of scour created by the presence of structures. Each substructure used for WTGs and OSPs may require individual scour protection. The type and amount of scour protection utilized will vary depending on the substructure used. For a substructure that utilizes seabed penetration in the form of piles or suction caissons, the use of scour protectant to prevent scour development results in minimized substructure penetration. Scour protection considered for the Project may include rock (rock bags), concrete mattresses, sandbags, artificial seaweeds/reefs/frond mats, or self-deploying umbrella systems (typically used for suction-bucket jackets). Installation activities and order of events of scour protection will depend on the type and material used. In the case of rock scour protection, a rock placement vessel may be deployed. A thin layer of filter stones would be placed prior to pile driving activity, while the armor rock layer would be installed following completion of pile driving activity. Frond mats or umbrella-based structures may be pre-attached to the substructure, in which case the pile and scour protection would be installed simultaneously. Final scour protection strategy and installation will be refined during detailed design. For all types of scour protection materials considered, the results of detailed geological campaigns and assessments will support the final decision of the extent of scour protection required. SouthCoast Wind will follow all best management practices and relevant regulations when installing scour protection around substructures. Placement of scour protection may result in suspended sediments and a minor conversion of marine mammal prey benthic habitat conversion of the existing sandy bottom habitat to a hard bottom habitat as well as potential beneficial reef effects (see Section 9.2 and COP Section 6.6 Benthic and Shellfish for additional details). However, the impacts from scour protection are expected to be infrequent and localized that they are unable to be meaningfully measured, evaluated, or detected and therefore, are not expected to result in take of marine mammals.

Seabed preparation may include leveling, sand wave removal, and boulder removal. SouthCoast Wind may utilize equipment to level the seabed locally in order to use seabed operated cable burial tools to ensure consistent burial is achieved. If sand waves are present, the tops may be removed to provide a level bottom to install the export cable. Sand wave removal may be conducted using a trailing suction hopper dredger (or similar), a water injection dredge in shallow areas, or a constant flow excavator. Any boulder discovered in the cable route during pre-installation surveys that cannot be easily avoided by micro-routing may be removed using a grab lift or plow as necessary. If deemed necessary, a pre-lay grapnel run will be conducted to clear the cable route of buried hazards along the installation route to remove obstacles that could impact cable installation such as abandoned mooring lines, wires, or fishing equipment. Site-specific conditions will be assessed prior to any boulder removal to ensure that boulder removal can safely proceed. Underwater noise associated with the described cable installation activities is primarily generated by the DP cable lay vessel thrusters. The noise from the DP thrusters (as described above) would be preceded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence, further reducing the potential for startle or flight responses on the part of marine mammals. Additionally, noise associated with other cable installation activities have been deemed by BOEM (COP Section 9.2 Underwater Acoustic Environment) as activities that may contribute non-impulsive sound (e.g., dredging, DP thrusters, vessel propulsion) to the environment. As described above, boulder clearance would be conducted by boulder grab and boulder plow methods which would result in the relocation and/or redistribution of the affected boulders. These processes will not involve explosive devices. Noise levels generated from these methods of boulder clearance are expected to be similar to noise levels produced by cable laying equipment and vessels. As seabed preparation activities are not expected to result in take of marine mammals, these activities are not analyzed further in this document.

### 1.3.1 Fisheries and Benthic Monitoring Plans

SouthCoast Wind has developed a fisheries monitoring plan (FMP) focusing on the offshore Project Area (i.e., Lease Area), an inshore fisheries monitoring plan that focuses on nearshore portions of the Brayton Point export cable corridor (i.e., the Sakonnet River), and a benthic monitoring plan (BMP) that covers both offshore and inshore portions of the Project Area. The fisheries and benthic monitoring plans for the Project were developed following guidance outlined in "Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf" (BOEM 2019). The BOEM guidelines state that a fishery survey plan should aim to:

- Identify and confirm which dominant benthic, demersal, and pelagic species are using the project site, and when 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 operations 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 operations.

BOEM also provides guidance related to survey gear types that can be used to conduct fisheries monitoring surveys including otter trawl, beam trawl, gillnet/trammel net, and ventless traps if those gear types will effectively sample species identified as appropriate target species. BOEM guidelines stipulate that two years of pre-construction fisheries monitoring data are recommended, and that data should be collected across all four seasons. The SouthCoast Wind offshore FMP was developed in consultation with BOEM.

Additional fisheries monitoring guidance was obtained from the Responsible Offshore Science Alliance (ROSA) "Offshore Wind Project Monitoring Framework and Guidelines" (2021). These guidelines build on existing BOEM guidance, outlining the fundamental elements to include in offshore wind fisheries monitoring plans and associated studies for commercial-scale offshore wind farms and identifying the primary resources to help draft and review such plans. Most of the research described in this plan will be performed on contracted commercial and recreational fishing vessels whenever practicable.

Along with being aligned with BOEM and ROSA guidelines, the inshore Fisheries Monitoring Plan, which focuses a portion of the export cable in Rhode Island waters, was developed in accordance with the RI Ocean Special Area Management Plan (OSAMP) and applicable sections of the RI Code of Regulations, notably 650-20-05 RI Code R. §11.9.9 (Baseline Assessment Requirements in state waters). This FMP was developed in an iterative approach and incorporated feedback from Rhode Island Department of Environmental Management, Massachusetts Division of Marine Fisheries, and Massachusetts Office of Coastal Zone Management.

Table 4 summarizes FMP and BMP survey types and associated marine mammal harassment potentials. Note that the table includes information on approximate timing of each survey component in terms of either months or calendar quarters when more specific timing is not yet known.

Table 4. Summary of fisheries and benthic monitoring plan survey types and marine mammal harassment potentials.

| Project Area | Activity/Type | Description | Potential Take Requested | Risk Assessment and Mitigation Measures |
|---|---|---|---|---|
| Offshore | Trawl Survey | Northeast Area Monitoring and Assessment Program (NEAMAP) style trawl survey to sample fish and invertebrate community. Occurring on seasonal basis (once per quarter). | None | Minimal Risk. Marine mammal monitoring prior to, during, and after haul back; no gear deployment if marine mammals observed in area |
| | Drop Camera Survey | Non-extractive, systematic drop camera video survey to assess benthic fish and invertebrate community. Occurring once in spring (Q2) and once in late summer (Q3). | None | Minimal Risk. Vessel mitigation measures will be employed while collecting optical samples. |
| | Ventless Trap Survey | Ventless trap survey in Lease Area focusing on American lobster, Jonah crab, and rock crabs, conducted in partnership with Massachusetts Lobstermen's Association. Following protocols and sampling design used by MA, | None | Minimal Risk. Mitigation measures on vessel movement will be used during deployment and retrieval. |

| | | | | |
|---|---|---|---|---|
| | | ME, and RI state surveys. Occurring every two weeks May through October. | | |
| | Neuston Net Survey | Plankton survey in Lease and Control Areas to assess larval abundance with a focus on American lobster larvae. Conducted in partnership with Massachusetts Lobstermen's Association. Occurring every two weeks May through October. | None | Minimal Risk. Vessel mitigation measures will be employed while collecting samples. |
| | Acoustic Telemetry | Highly Migratory Species (bluefin tuna, shortfin mako sharks, blue sharks) will be tagged. Study will use an array of acoustic receivers across MA/RI WEA to track fish movement. Acoustic release receiver deployment in May, tagging from June through September, receiver retrieval in December. | None | Minimal risk. Vessel mitigation measures described in this section will be employed. |
| Inshore | Acoustic Telemetry | Acoustic tagging survey targeting commercially and recreationally important species such as striped bass, summer flounder, tautog, little tunny. Species presence, persistence, and movements will be monitored over time. Acoustic release receiver deployment in April, retrieval in November, with tagging efforts occurring regularly in between. Occurring in RI state waters near mouth of the Sakonnet River. | None | Minimal Risk. Vessel mitigation measures will be employed while deploying tags and deploying/retrieving acoustic receivers. |
| | Whelk Trap | Trap survey to monitor whelk relative abundance and size structure along commercially fished sections of the export cable corridor in the Sakonnet River. The survey will identify potential impacts from the short-term disturbance of submarine cable installation on the localized channeled and knobbed whelk resources. Occurring May through November, sampling every two weeks. | None | Minimal Risk. Vessel mitigation measures will be employed while deploying/retrieving traps. |
| Offshore/Inshore | Benthic Monitoring | Hard bottom habitat monitoring using a remotely operated vehicle | None | Minimal risk is anticipated due to the nature of this activity. Vessel |

| | | |
|---|---|---|
| | (ROV) with stereoscopic cameras to characterize community composition. Soft bottom habitat monitoring using Sediment Profile and Plan View Imaging (SPI/PV) to measure changes in benthic function with respect to time and distance. Surveying activities will occur in the third quarter of each sampling year to align with peak biomass and diversity of benthic organisms | mitigation measures will be employed while deploying and retrieving the ROV and SPI/PV camera. |

On-water activities associated with the FMPs and benthic monitoring plan are bound by several mitigation measures in addition to mitigations for specific gear types. All vessels will comply with applicable vessel speed regulations and mitigation measures specified in Section 11.All vessel operators and crews supporting FMP and BMP surveys will receive protected species identification training and maintain a vigilant watch for marine mammals and other protected species and will respond with the appropriate action to avoid vessel strikes (e.g., change course, slow down, navigate away from animal, etc.). At least one survey staff on board the trawl survey will have completed the Northeast Fisheries Observer Program (NEFOP), the NMFS-required PSO training within the last five years, or other equivalent training in protected species identification and safe handling. Vessels will maintain the following separation distances from marine mammals:

- >500 m distance from any sighted NARW or an unidentified large marine mammal,
- >100 m from sperm whales and non-NARW baleen whales,
- >50 m from all delphinid cetaceans and pinnipeds, with the exception of animals approaching the vessel (e.g., bow-riding dolphins), in which case the vessel operator must avoid excessive speed or abrupt changes in direction.

All attempts will be made to remain parallel to an observed marine mammal's course, slow down, and avoid excessive speed or abrupt changes in direction when sighted in proximity to a transiting vessel. If a marine mammal or group of marine mammals are observed in a vessel's path, attempts will be made to divert away from the animal(s) and/or reduce speed and shift gears to neutral until the animal(s) have moved beyond the designated separation distances described above and in Section 11.1.5.2 (with the exception of voluntary bow riding dolphin species). Additional vessel strike avoidance measures are described in Section 11.1.5.3.

Operators and crew aboard fisheries and benthic survey vessels will be engaged in regular marine mammal watches during daylight hours prior to the deployment of survey gear (e.g., trawls, ventless traps, etc.) and will continue until gear is brought back on board. If marine mammals are observed in the survey area within 15 minutes prior to deployment of research gear and are considered to be at risk of interaction with said gear, the sampling station will be moved, canceled, or suspended until there are no sightings for 15 minutes within 1 nm of the sampling location.

#### *1.3.1.1 Gear Specific Mitigation Measures*

Gear specific mitigation measures will be employed in addition to the general mitigation measures outlined above to avoid the potential for interactions with MMPA species.

The following mitigation measures will be used to minimize the potential for marine mammal capture during the research trawling:

- All gear restrictions, closures, and other regulations set forth by take reduction plans (e.g., Harbor Porpoise Take Reduction Plan, Atlantic Large Take Whale Reduction Plan, etc.) will be adhered to as with typical scientific fishing operations to reduce the potential for interaction or injury;
- Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before, during, and after haul back. When the captain and/or member of the scientific crew are designated as the dedicated PSO, it is their sole responsibility for the duration of the haul;
- Trawl operations will commence as soon as possible once the vessel arrives on station; the target tow time will be limited to 20 minutes;
- SouthCoast Wind will conduct marine mammal watches (visual observation) when sampling and while transiting to/from sampling stations;
- Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk of interaction, all gear will be immediately removed;
- SouthCoast Wind will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (i.e., throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, SouthCoast Wind will take the most appropriate action to avoid marine mammal interaction;
- SouthCoast Wind will open the codend of the net close to the deck/sorting area to avoid damage to animals that may be caught in gear; and
- Gear will be emptied as close to the deck/sorting area and as quickly as possible after retrieval;
- Trawl nets will be fully cleaned and repaired (if damaged) before setting again.

SouthCoast Wind does not anticipate and is not requesting take of marine mammals incidental to research trawl surveys but, in the case of a marine mammal interaction, the Marine Mammal Stranding Network will be contacted immediately.

### Ventless Trap Survey (Offshore)

In addition to the general mitigation measures outlined above, the ventless trap surveys will employ the following mitigation measures to minimize the potential for an interaction with protected species associated with vertical lines:

- All sampling gear will be hauled at least once every 30 days, and all gear will be removed from the water at the end of each sampling season (November).
- All groundlines will be constructed of sinking line
- Fishermen contracted to perform the field work will be encouraged to use knot-free buoy lines.
- To reduce the potential risk to right whales, buoy/end lines with a breaking strength of <1700lbs will be used. All buoy lines will use weak links that are chosen from the list of NMFS-approved gear. This may be accomplished by using whole buoy line that has a breaking strength of 1700lbs; or buoy line with weak inserts that result in line having an overall breaking strength of 1700lbs.

- All buoys and traps will be labeled as research gear, and the scientific permit number will be written on the buoy and on a tag attached to every trap. All markings on the buoys and buoy lines will be compliant with the regulations, and all buoy markings will comply with instructions received by staff at NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division.
- Any lines or trawls that go missing will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division as soon as possible.

# 2 Dates, Duration, and Specified Geographic Region

## 2.1 Dates and Construction Activities

The SouthCoast Wind Lease Area will be developed in two phases or "projects". To allow flexibility in the final design and during the construction period, different proposed construction schedules, separated by Project and foundation type (monopile and jacket) are shown below in Figure 9. The construction schedules show potential foundation installations occurring in more than one year for each project because the year in which installations might occur is not currently known; however, it is expected that foundation installations would occur in a single year for each project. The full build out of the Lease Area will consist of up to two different foundation types that have the potential to result in harassment to marine mammals. Offshore construction activities in the SouthCoast Wind Lease Area and ECCs for Projects 1 and 2 will occur over approximately 6 years, staring in the fourth quarter of 2026 and continuing through 2031. However, take-producing activities are not expected to begin until 2027 since export cable installation is not expected to result in take. During this time, some activities will occur 24-hours a day in order to minimize the overall duration of activities and the associated period of potential impact on marine mammals. This may include impact and/or vibratory pile driving of WTG and OSP foundations during nighttime hours. The installation of foundations will be completed following a sequencing pattern. Beginning on June 1, installations occurring within the 20-km area of concern will begin at the northern-most position within the Lease Area and will progress in a north to south direction moving away from Nantucket Shoals. No vibratory pile driving will be used during the installation of the first 72 foundation positions in the northern portion of the Lease Area (Project 1) which includes the 20-km area of concern. And no pile driving for foundation installations will occur from January 1 – May 14 of each year. The total number of construction days will be dependent on a number of factors, including environmental conditions, planning, construction, and installation logistics. The general construction schedule for both Project 1 and Project 2 is provided in Figure 9. The installation schedule includes all of the major Project components including those that may result in harassment takes and those that are not expected to result in any take.

After construction is completed and through the end of the effective period for the requested regulations, HRG surveys could take place within the SouthCoast Wind Project Area at any time of year. It is anticipated that the annual amount of survey activity will be less than during construction years.

## 2.2 Specified Geographical Region of Activity

The offshore components of the Project, including the WTGs, OSPs, IAC, and a portion of the export cables will be located in federal waters in the SouthCoast Wind Lease Area OCS A-0521. The maximum water depth in the Lease Area is 64 m, with 48 of 149 foundation positions located in water depths of 54-64 m and the other 101 located at depths <54 m. The proposed ECCs will traverse both federal and state territorial waters of Massachusetts and Rhode Island. Refer to Figure 1 for a depiction of both the Lease Area and ECCs (Project Area).

During construction, the Project will require support from temporary construction laydown yard(s) and construction port(s). The operational phase of the Project will require support from onshore O&M facilities. While a final decision has not yet been made, SouthCoast Wind will likely use more than one marshalling port for the proposed Project. The following ports are under consideration: New Bedford, MA; Fall River, MA; South Quay, RI; Sheet Harbor, Canada; Salem Harbor, MA; Port of New London, CT; Port of Charleston, SC; Port of Davisville, RI; and Sparrows Point Port, Maryland.  Section 3.3.13 of the COP describes the specific ports being considered and their potential usage.

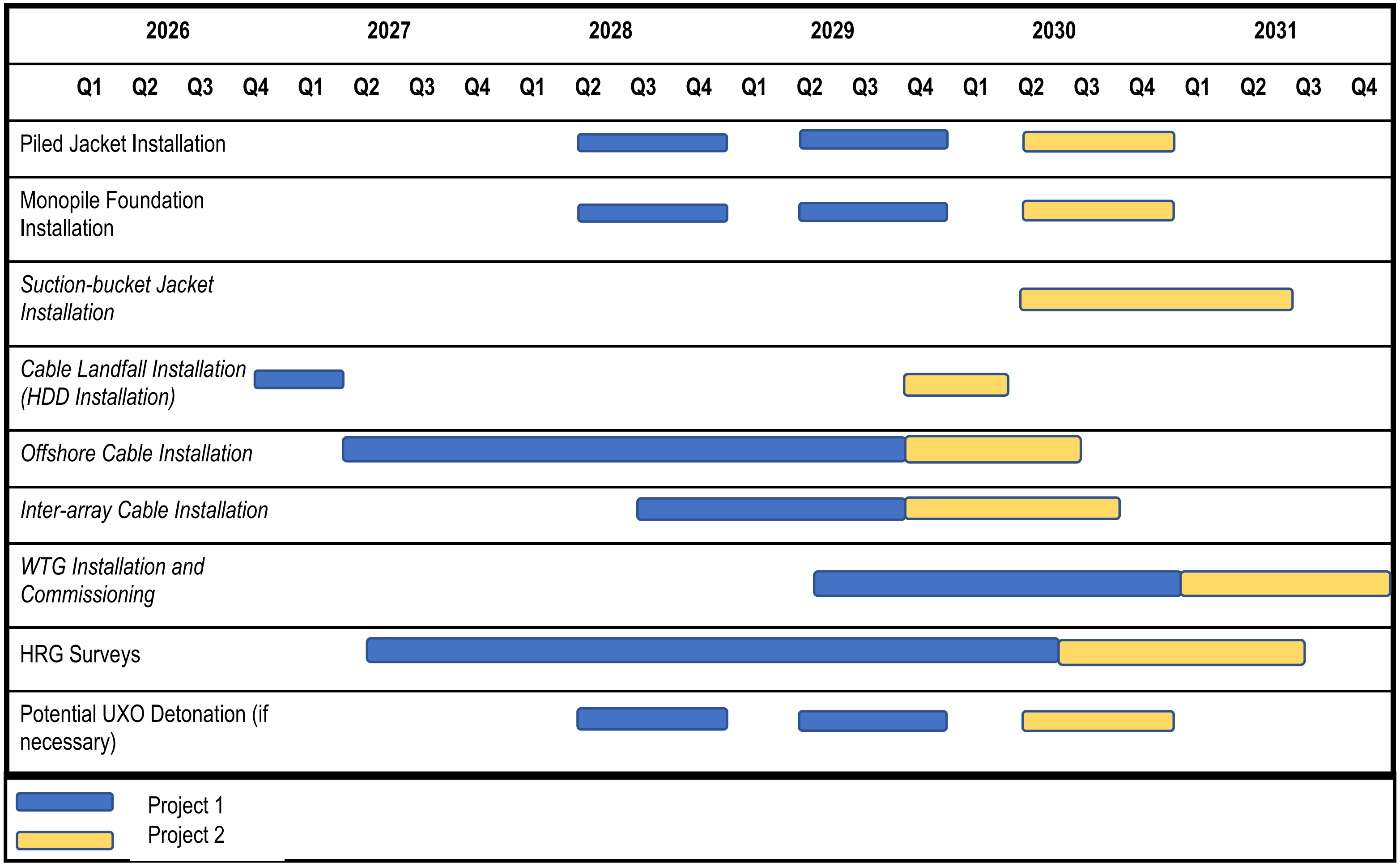

Figure 9. Nominal installation periods for the major SouthCoast Wind Project components. Project components in italics are not anticipated to cause take.

# 3 Species and Number of Marine Mammals

## 3.1 Species Present

Table 5 lists the 31 marine mammal species that potentially could occur within the Lease Area and surrounding waters, along with their listing status under the *Endangered Species Act* (ESA), habitat, their relative likelihood of occurrence, and their documented abundance in the region. Additional details of species abundances are provided in Section 4 below in the individual species descriptions. The species in the region include six species of large baleen whale (mysticetes); 20 species of large and small toothed whales, dolphins, and porpoise (odontocetes); four species of earless seals (phocid pinnipeds); and one sirenian (West Indian manatee). It is unlikely that all 31 species would be present in the Lease Area and Export Cable Corridors (ECCs) during construction activities because some of them are seasonal migrants and because their distributions vary among years based on factors such as oceanographic characteristics and prey availability.

Five of the species known to occur in the Lease Area and surrounding waters are listed under the Endangered Species Act (ESA); these include the blue whale (Endangered), fin whale (Endangered), North Atlantic right whale (Endangered), sei whale (Endangered), and sperm whale (Endangered). All five of these species are expected to occur in the Project Area and are considered potentially affected species. The blue whale is uncommon in the SouthCoast Wind Project Area; however, blue whale vocalizations and sighting data in the region demonstrate the possibility for the species to be present in the Project Area. The following sections provide further information regarding species occurrence in the Project Area.

The abundance information included within Table 5 was included from the 2022 Marine Mammal Stock Assessment Reports (Hayes et al. 2023). Table 5 evaluates the potential occurrence of marine mammals in the Project Area based on three categories defined as follows:

- **Common** – Occurring consistently in moderate to large numbers;
- **Uncommon** – Occurring in low numbers or on an irregular basis;
- **Rare** – Records for some years but limited; and

Seasonality and occurrence reported in and discussed below were mainly derived from the Northeast Large Pelagic Survey Collaborative (NLPSC) aerial surveys of the Rhode Island/Massachusetts Wind Energy Areas (RI/MA WEAs) during 2011–2015 (Kraus et al. 2016), Roberts et al. (2016; 2023) habitat-based density models, the Kenney and Vigness-Raposa (2010) marine mammal assessment for the Rhode Island Ocean Special Area Management Plan, and the 2022 NOAA Fisheries Stock Assessment Reports (Hayes et al. 2023). Additional sighting data from Atlantic Marine Assessment Program for Protected Species (AMAPPS) shipboard and aerial surveys is also reported where relevant (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

Of the 31 marine mammal species listed in Table 5, fifteen species are not expected to be present or are considered to be "rare" in the Project Area based on sighting and distribution data, low predicted densities, or lack of preferred habitat. These are the dwarf and pygmy sperm whales (*Kogia sima* and *K. breviceps*), short-finned pilot whale (*Globicaphalus macrorhynchus*), Cuvier's beaked whale (*Ziphius cavirostris*), killer whale (*Orcinus orca)* four species of Mesoplodont beaked whales—Blainsville's (*Mesoplodon densirostris*), Gervais' (*M. europaeus*), Sowerby's (*M. bidens*), and True's (*M. mirus*)—pantropical spotted dolphin (*Stenella attenuata*), Atlantic spotted dolphin (*Stenella frontalis*), striped dolphin (*Stenella coeruleoalba*), white-beaked dolphin (*Lagenorhynchus albirostris*), hooded seal (*Crysophora cristata),* and West Indian manatee (*Trichechus manatus)* (Kenney and Vigness-Raposa 2010; Kraus et al. 2016; Roberts et al. 2016; Hayes et al. 2023). Due to their limited occurrence in the Project Area, the likelihood that individuals from one of these species would be taken by harassment during the construction activities is negligible so they are not carried forward in this ITR Application.

Table 5. Marine mammals that could be present in the Project Area. NA means not available.

| Common Name (Species Name) and Stock | ESA/MMPA Status[a] | Habitat[b] | Occurrence in MA WEA[c] | Seasonality in MA WEA[d] | Abundance[e] (NOAA Fisheries best available) |
|---|---|---|---|---|---|
| **Mysticetes** | | | | | |
| Blue whale<br>(*Balaenoptera musculus*)<br>Western North Atlantic Stock | Endangered/ Strategic | Pelagic and coastal | Uncommon | Mainly winter, but rare year-round | 402 |
| Fin whale<br>(*Balaenoptera physalus*)<br>Western North Atlantic Stock | Endangered/ Strategic | Slope, pelagic | Common | Year-round, but mainly spring and summer | 6,802 |
| Humpback whale<br>(*Megaptera novaeangliae*)<br>Gulf of Maine Stock | Not Listed/Not Strategic | Mainly nearshore and banks | Common | Year-round, but mainly spring and summer | 1,396 |
| Minke whale<br>(*Balaenoptera acutorostrata*)<br>Canadian East Coast Stock | Not Listed/Not Strategic | Coastal, shelf | Common | Spring, summer, and fall (March to September) | 21,968 |
| North Atlantic right whale<br>(*Eubalaena glacialis*)<br>Western North Atlantic Stock | Endangered/ Strategic | Coastal, shelf, offshore | Common | Winter and spring (December to May) | 338 |
| Sei whale<br>(*Balaenoptera borealis*)<br>Nova Scotia Stock | Endangered/ Strategic | Mostly pelagic | Common | Spring and summer (March to June) | 6,292 |
| **Odontocetes** | | | | | |
| Atlantic spotted dolphin<br>(*Stenella frontalis*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Continental shelf, slope | Rare | NA | 39,921 |
| Atlantic white-sided dolphin<br>(*Lagenorhynchus acutus*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Offshore, slope | Common | Year-round | 93,233 |
| Common bottlenose dolphin<br>(*Tursiops truncatus*)<br>Western North Atlantic Offshore Stock[f] | Not Listed/Not Strategic | Coastal, shelf, deep | Common | Year-round | 62,851 |

| Common Name (Species Name) and Stock | ESA/MMPA Status[a] | Habitat[b] | Occurrence in MA WEA[c] | Seasonality in MA WEA[d] | Abundance[e] (NOAA Fisheries best available) |
|---|---|---|---|---|---|
| Cuvier's beaked whale<br>(*Ziphius cavirostris*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Pelagic | Rare | NA | 5,744 |
| Dwarf sperm whale<br>*(Kogia sima)*<br>Western North Atlantic Stock | Not Listed/Not Strategic | Deep, shelf, slope | Rare | NA | 7,750[g] |
| Harbor porpoise<br>(*Phocoena phocoena*)<br>Gulf of Maine/Bay of Fundy Stock | Not Listed/Not Strategic | Shelf | Common | Year-round, but less abundant in summer | 95,543 |
| Killer Whale<br>(*Orcinus orca*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Offshore and mid-ocean | Rare | NA | Unknown |
| Mesoplodont Beaked Whales[f]<br>*(Mesoplodon densitostris, M. europaeus, M. mirus, and M. bidens)*<br>Western North Atlantic Stock | Not Listed/Not Strategic | Slope, offshore | Rare | NA | 10,107[h] |
| Pantropical spotted dolphin<br>(*Stenella attenuata)*<br>Western North Atlantic Stock | Not Listed/Not Strategic | Pelagic | Rare | NA | 6,593 |
| Pilot whale, long-finned<br>(*Globicephalus melas*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Continental shelf edge, high relief | Uncommon | Year-round | 39,215 |
| Pilot whale, short-finned<br>(*Globicaphalus macrorhynchus*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Pelagic, high relief | Rare | NA | 28,924 |
| Pygmy Sperm Whale<br>*(Kogia breviceps)*<br>Western North Atlantic Stock | Not Listed/Not Strategic | Pelagic | Rare | NA | 7,750[g] |
| Risso's dolphin<br>(*Grampus griseus*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Shelf, slope | Uncommon | Year-round | 35,215 |
| Common dolphin<br>(*Delphinus delphis)*<br>Western Atlantic Stock | Not Listed/Not Strategic | Shelf, pelagic | Common | Year-round, but more abundant in summer | 172,974 |

| Common Name (Species Name) and Stock | ESA/MMPA Status[a] | Habitat[b] | Occurrence in MA WEA[c] | Seasonality in MA WEA[d] | Abundance[e] (NOAA Fisheries best available) |
|---|---|---|---|---|---|
| Sperm whale<br>(*Physeter macrocephalus*)<br>North Atlantic Stock | Endangered/ Strategic | Pelagic, steep topography | Uncommon | Mainly summer and fall | 4,349 |
| Striped dolphin<br>(*Stenella coeruleoalba*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Off continental shelf | Rare | NA | 67,036 |
| White-beaked dolphin<br>(*Lagenorhynchus albirostris*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Off continental shelf | Rare | NA | 536,016 |
| **Pinnipeds** | | | | | |
| Gray seal<br>(*Halichoerus grypus*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Nearshore, shelf | Common | Year-round | 27,300 |
| Harbor seal<br>(*Phoca vitulina*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Coastal | Common | Year-round, but rare in summer | 61,336 |
| Harp seal<br>(*Pagophilus groenlandicus*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Nearshore | Uncommon | Winter and spring | 7.6 M |
| Hooded Seal<br>(*Crysophora cristata*)<br>Western North Atlantic Stock | Not Listed/Not Strategic | Off continental shelf | Rare | NA | Unknown |
| **Sirenians** | | | | | |
| West Indian Manatee<br>(*Trichechus manatus*)<br>Florida Stock | Threatened/ Depleted | Nearshore | Rare | NA | 13,000[i] |

NA= Not applicable and/or insufficient data available to determine seasonal occurrence in the offshore project area.

[a] Listing status under the US Endangered Species Act (ESA), NMFS (Hayes et al. 2023), and Marine Mammal Protection Act (MMPA).

[b] Habitat descriptions from the 2022 Marine Mammal Stock Assessment Reports (Hayes et al. 2023).

[c] Occurrence in the Massachusetts Wind Energy Area (MA WEA) is mainly derived from Hayes et al. (2023), Kenney and Vigness-Raposa (2010), Kraus et al. (2016), and Roberts et al. (2016; 2023).

[d] Seasonality in the MA WEA was mainly derived from Kraus et al. (2016) and Kenney and Vigness-Raposa (2010).

[e] "Best Available" abundance estimate is from the 2022 Marine Mammal Stock Assessment Reports (Hayes et al. 2023).

[f] Common bottlenose dolphins occurring in the MA Wind Energy Area likely belong to the Western North Atlantic Offshore Stock. It is possible that some could belong to the Western North Atlantic Northern Migratory Coastal Stock (listed as depleted under the MMPA), but the northernmost range of that stock is south of the Lease Area.

[g] Includes both dwarf and pygmy sperm whales (Hayes et al. 2023).

[h] Mesoplodont beaked whale abundance estimate accounts for all undifferentiated beaked whale species within the Western Atlantic (Hayes et al. 2023).

i Under management jurisdiction of United States Fish and Wildlife Service rather than National Marine Fisheries Service (USFWS 2019).

# 4 Affected Species Status and Distribution

Of the 31 marine mammal species and/or stocks with geographic ranges within the Lease Area and surrounding waters, 15 species can be expected to reside, traverse, or routinely visit the Project Area in densities that could result in acoustic exposures from proposed activities, and therefore, be considered potentially affected species. Of the species with relative occurrence considered "rare" (Table 5), the likelihood of exposure is deemed low. Therefore, these species are not carried forward in the modelling analysis of this ITR Application as the chances for take are negligible. The 15 potentially affected species include:

1. Blue Whale
2. Fin whale;
3. Humpback whale;
4. Minke whale;
5. North Atlantic right whale;
6. Sei whale;
7. Atlantic white-sided dolphin;
8. Common bottlenose dolphin;
9. Harbor porpoise;
10. Long-finned pilot whale
11. Risso's dolphin;
12. Short-beaked common dolphin;
13. Sperm whale;
14. Grey seal; and
15. Harbor seal.

The following subsections summarize the information available on the life history, hearing and communication frequencies, habitat preferences, distribution, abundance, and status of marine mammals expected to occur in the Project Area and be potentially affected.

## 4.1 Mysticetes

### *4.1.1 Blue Whale (Balaenoptera musculus musculus)*

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. Most adults of this subspecies 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; Lesage et al. 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 Project Area during acoustic surveys (Kraus et al. 2016). However, the blue whale vocalizations could have originated at large distances from the receivers, meaning the detections in or near the Project Area do not necessarily mean blue whale presence within the Project Area. Two sightings of two individual blue whales were observed ~100 km east of the Project Area during the AMAPPS surveys in 2016 (Palka 2017). More recently, during three years of monthly area surveys in the New York Bight from 2017–2020, Zoidis et al. (2021) reported 3 sightings of 5 individuals.

#### *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 Project 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 2021l), with a maximum length of about 22.8 m (75 ft). 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).

### *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 (Hayes et al. 2022). The population is divided by ocean basins; however, these boundaries are arbitrary as they are based on historical whaling patterns rather than biological evidence (Hayes et al. 2022). 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., sea lance, capelin, herring), krill, copepods, and squid in deeper waters near the edge of the continental shelf (90 to 180 m [295 to 591 ft]) 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 (Vigness-Raposa et al. 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 (Hayes et al. 2022). Between April 2020 and December 2021, there were 15 sightings of 24 individual individual fin whales recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC .

Kraus et al. (2016) suggest that, compared to other baleen whale species, fin whales have a high multi-seasonal relative abundance in the Rhode Island/Massachusetts (RI/MA) and MA WEAs and surrounding areas. Fin whales were observed during spring and summer of the 2011–2015 NLPSC aerial survey. This species was observed primarily in the offshore (southern) regions of the RI/MA and 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 RI/MA and MA WEAs in the fall and winter months (Kraus et al. 2016), acoustic data indicated that this species was present in the RI/MA and 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 nm), detected signals may have originated from areas far outside of the RI/MA and 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. Fin whales were observed in the MA WEA and nearby waters during spring and summer of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

### *4.1.2.2 Abundance*

The best abundance estimate available for the Western North Atlantic stock is 6,802 based on data from NOAA shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys (Hayes et al. 2022). A population trend analysis does not currently exist for this species 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; Hayes et al. 2022).

#### *4.1.2.3 Status*

Fin whales are listed as Endangered under the ESA and are listed as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List (Hayes et al. 2022; IUCN 2023). This stock is listed as strategic and depleted under the MMPA due to its Endangered status (Hayes et al. 2022). Potential Biological Removal (PBR) for the western North Atlantic fin whale is 11 (Hayes et al. 2022). PBR being 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) (Hayes et al. 2022). Annual human-caused mortality and serious injury for the period between 2015 and 2019 was estimated to be 1.85 per year (Hayes et al. 2022). This estimate includes incidental fishery interactions (i.e., bycatch/entanglement) and vessel collisions, but other threats to fin whales include contaminants in their habitat and potential climate-related shifts in distribution of prey species (Hayes et al. 2022). The Lease 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).

### *4.1.3 Humpback Whale (Megaptera novaengilae)*

Humpback whale females are larger than males and can reach lengths of up to 18 m (60 ft) (NMFS 2021i). 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. 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 $\mathrm{SPL_{rms}}$ (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 $\mathrm{SPL_{rms}}$ (Thompson et al. 1986; Erbe et al. 2017). Anatomical modeling based on humpback whale ear morphology indicate that their best hearing sensitivity is between 18 Hz and 15 kHz (Ketten et al. 2014; Southall et al. 2019).

#### *4.1.3.1 Distribution*

The humpback whale can be found worldwide in all major oceans from the equator to sub-polar latitudes. In the summer, humpbacks are found in 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 feeding areas 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, and there have also been numerous winter sightings in the Southeastern U.S. (Hayes et al. 2020). Feeding behavior has also been observed in New England off Long

Island, New York, and survey data from NOAA suggests a potential increase in humpback whale abundance off New Jersey and New York (Hayes et al. 2020). Between April 2020 and December 2021, there were 82 sightings of 222 individual humpback whales recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC .

Kraus et al. (2016) observed humpback whales in the RI/MA and MA WEAs and surrounding areas during all seasons of the 2011–2015 NLPSC aerial survey. 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 passive acoustic monitoring (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. Humpback whales were observed in the MA WEA and nearby waters during the spring and summer of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### *4.1.3.2 Abundance*

The best available abundance estimate of the Gulf of Maine stock is 1,396, 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).

#### *4.1.3.3 Status*

NMFS revised the listing status for humpback whales under the ESA in 2016 (81 FR 62260 2016). Globally, there are 14 distinct population segments (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 Project Area is considered non-strategic under the MMPA and does not coincide with any ESA-list DPS (Hayes et al. 2020). This stock is considered non-strategic because the detected level of U.S. fishery-caused mortality and serious injury derived from the available records do 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 PBR. While detected mortalities yield an estimated minimum fraction anthropogenic mortality at 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. A UME was declared for this species in January 2016, which as of October 2023 has resulted in 209 stranded humpback whales, with 41 of those occurring off Massachusetts (Hayes et al. 2020; NMFS et al. 2023a). A BIA for humpback whales for feeding has been designated northeast of the Lease 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).

### 4.1.4 Minke Whale (Balaenoptera acustorostrata)

Minke whales are a baleen whale species reaching 10 m (35 ft) 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 2021h).

In the North Atlantic, minke whales commonly produce pulse trains lasting 10 to 70 sec 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 $\mathrm{SPL_{rms}}$ (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 1 to 5 kHz with an SLs of approximately 150 dB re 1 µPa @ 1 m $\mathrm{SPL_{rms}}$ (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).

#### 4.1.4.1 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 (Hayes et al. 2022). They are most abundant in New England waters in the spring, summer, and early fall (Hayes et al. 2022). 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. 2014a). Between April 2020 and December 2021, there were 36 sightings of 44 individual minke whales recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC .

Kraus et al. (2016) observed Minke whales in the RI/MA and 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. Minke whales were observed several times in the MA WEA and nearby waters during spring and summer of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### 4.1.4.2 Abundance

The best available current global abundance estimates for the common minke whale, compiled by the IUCN Red List, is around 200,000 (Graham and Cooke 2008). The most recent population estimate for the Canadian East Coast stock which occurs in the Project Area is 21,968 minke whales, derived from surveys conducted by NOAA and the Department of Fisheries and Oceans Canada between Labrador and central Virginia . There are no current population trends or net productivity rates for this species due to insufficient data.

#### *4.1.4.3 Status*

Minke whales are not listed under the ESA or classified as strategic under the MMPA. They are listed as Least Concern on the IUCN Red List . The estimated annual human-caused mortality and serious injury from 2015 to 2019 was 10.55 per year attributed to fishery interactions, vessel strikes, and non-fishery entanglement in both the U.S. and Canada , and a UME was declared for this species in January 2017, which is ongoing (NMFS 2022a). As of October 2023, a total of 160 strandings have been reported, with 56 of those occurring off Massachusetts (NMFS 2023b). The PBR for this stock is estimated to be 170 (Hayes et al. 2022). A BIA for Minke whales for feeding has been designated east of the Lease 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 (Hayes et al. 2022).

### *4.1.5 North Atlantic Right Whale (Eubalaena glacialis)*

NARWs are among the rarest of all marine mammal species in the Atlantic Ocean. They average approximately 15 m (50 ft) in length (NMFS 2021a). They have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera Hayes et al. (2023). NARWs are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NMFS 2021a). 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 $\mathrm{SPL}_{\mathrm{rms}}$ (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).

#### *4.1.5.1 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 Atlantic stock of NARWs ranges primarily from calving grounds in coastal waters of the southeastern U.S.to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence Hayes et al.

(2023). 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 Atlantic stock. This stock 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 Hayes et al. (2023). 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 8-year analysis of NARW sightings within southern New England (SNE) show that the NARW distribution has been shifting (Quintana-Rizzo et al. 2021). The study area of SNE (shores of Martha's Vineyard and Nantucket to and covering all the offshore wind lease sites of Massachusetts and Rhode Island) recorded sightings of NARWs in almost all months of the year with the highest sighting rates occurring during winter months into early spring (Quintana-Rizzo et al. 2021). Between January 2021 to present, there have been 68 sightings of NARW within the Nantucket Shoals (O'Brien et al. 2020a; O'Brien et al. 2020b; O'Brien et al. 2022).

The winter distribution of NARWs 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 rage throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). 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 clime-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 et al. 2019; Davies and Brillant 2019; Record et al. 2019). Despite considerable survey effort, the location of most of the population during the 2010-2014 foraging seasons are 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).

Surveys demonstrate the existence of seven areas where NARWs 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). National Oceanic and Atmospheric Administration (NOAA) Fisheries 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 (DoC 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).

Kraus et al. (2016) observed NARWs in the RI/MA and 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 sightings per unit effort (SPUE) in the RI/MA and MA WEAs was in March. Seventy-seven unique individual NARWs were observed in the RI/MA and 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.

During recent surveys conducted in the MA and RI/MA WEAs there were 112 sightings of 164 individual NARWs during directed surveys between October 2018 and August 2019 (O'Brien et al. 2020a). In contrast with the aerial surveys conducted by Kraus et al. (2016), NARWs were observed in or near the MA and RI/MA WEAs during every season, with the highest number of sightings 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 (O'Brien et al. 2020a). Sighting rates were higher in the fall than summer, and the feeding aggregation observed in previous years during the summer were absent (O'Brien et al. 2020b). During the most recent surveys conducted in and near the MA and RI/MA WEAs between September 2020 and October 2021, there were 90 sightings of 169 NARWs (O'Brien et al. 2022). NARWs were sighted over the Nantucket Shoals during all seasons except for spring. During spring months, NARWs were aggregated in or near the MA and RI/MA WEAs (O'Brien et al. 2022).

Roberts et al. (2021) predict that the highest density of NARWs in the MA WEA and adjacent waters occurs in April, and Kraus et al. (2016) reported greatest levels of SPUE of NARWs in the WEA in March. The NLPSC aerial surveys report no sightings of NARWs for the months of May through October and reported only four sightings in December across all survey years (Kraus et al. 2016). NARWs were observed in the MA WEA and nearby waters during the winter, spring, and summer of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). Sightings of this species in the Lease Area are possible at any time of year, though NARWs are generally distributed further north at the time of year when the proposed construction is scheduled to occur.

#### *4.1.5.2 Abundance*

The Western North Atlantic population size was estimated to be 338 individuals in the 2022 Stock Assessment report, which used data from the photo-identification database maintained by the New England Aquarium that were available in November 2020 (Hayes et al. 2023). However, the Right Whale Consortium 2020 Report Card estimates the NARW population to be 336 individuals (Pettis et al. 2021). 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 2020 when the final estimate was 338 individuals (Hayes et al. 2023). Based on the abundance estimates between 2011 and 2020, there was an overall abundance decline of 23.5% (CI= 21.4 to 26%) (Hayes et al. 2023). Modeling conducted by Pace et al. (2021) showed a decline in annual abundance after 2011, which has likely continued as evidenced by the decrease in the abundance estimate from 451 in 2018 (Hayes et al. 2019) to 368 in 2021 (Hayes et al. 2021). Highly variable data exist regarding the productivity of this stock. Over time, there have been periodic swings of per capita birth rates . Net productivity rates do not exist as the Western North Atlantic stock lacks any definitive population trend .

#### *4.1.5.3 Status*

The NARW is listed as Endangered under the ESA and are listed as Critically Endangered by the IUCN Red List . NARWs are considered to be the most critically Endangered large whales in the world . 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 Hayes et al. (2023). Estimated human-caused mortality and serious injury between 2016 and 2020 was 8.1 whales per year Hayes et al. (2023). Using refined methods of Pettis et al. (2021), the estimated annual rate of total mortality for the period of 2015-2019 was 31.2, which is 4.1 times larger than the 7.7 total derived from reported mortality and serious injury for the same period Hayes et al. (2023). Vessel strike and entanglement are two of the highest causes of strandings for NARW within the Atlantic. A UME was declared for this species in 2017, which as of October 2023 has resulted in 121 documented dead, serious, or sub-lethal injuries/illnesses (NMFS et al. 2023c). This includes 36 mortalities with 12 of those resulting from vessel strike and 9 from entanglement (NMFS et al. 2023c) and 34 serious injuries resulting from entanglement (31) and vessel strike (2) (NMFS et al. 2023c).

To protect this species from ship strikes, NOAA Fisheries designated Seasonal Management Areas (SMAs) in U.S. waters in 2008 ([NMFS] National Marine Fisheries Service 2008). All vessels greater than 65 ft (19.8 m) in overall length must operate at speeds of 10 knots or less within these areas during specific time periods. The Block Island Sound Seasonal Management Area (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 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 ([NMFS] National Marine Fisheries Service 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 Lease 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 RI/MA and 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). Pile driving of foundations is scheduled to occur from May 15 through December and any potential UXO detonations would occur from May through November. These activities thus overlap with the timing of the southward migration in November and December. HRG surveys could occur at any time of the year.

### *4.1.6 Sei Whale (Balaenoptera borealis)*

Sei whales are a baleen whale that can reach lengths of about 12–18 m (40–60 ft) (NMFS 2021k). This species has a long, sleek body that is dark bluish gray to black in color and pale underneath (NMFS 2021k). Their diet is comprised primarily of plankton, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NMFS 2021k).

Although uncertainties still exist with distinguishing sei whale vocalizations during PAM surveys, they are known to produce short duration (0.7 to 2.2 sec) 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).

#### *4.1.6.1 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; Hayes et al. 2020). 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, utilizing the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) as feeding grounds, including the Gulf of Maine and Georges Bank. 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. Passive acoustic monitoring (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 Southern New England (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 (Hayes et al. 2022). In general, sei whales are observed offshore with periodic incursions into more shallow waters for foraging (Hayes et al. 2022). Between April 2020 and December 2021, there were four sightings of six individual sei whales recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC.

Kraus et al. (2016) observed sei whales in the RI/MA and 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. Sei whales were not observed in the MA WEA and nearby waters during the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). However, there were observations during the 2016 and 2017 summer surveys that were identified as being either a fin or sei whale. Sei whales are expected to be present in the Lease Area and surrounding waters but much less common than the other baleen whale species.

#### *4.1.6.2 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 International Whaling Commission (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 U.S. waters, and the current abundance estimate for this population is 6,292 derived from recent surveys conducted between Halifax, Nova Scotia and Florida (Hayes et al. 2022). Population trends are not available for this stock because of insufficient data (Hayes et al. 2022).

#### *4.1.6.3 Status*

Sei whales are listed as Endangered under the ESA and by the IUCN Red List . This stock is listed as strategic and depleted under the MMPA due to its Endangered status (Hayes et al. 2022). Annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 0.8 per year (Hayes et al. 2022). The PBR for this stock is 6.2 (Hayes et al. 2022). Like fin whales, major threats to sei whales include fishery interactions, vessel collisions, contaminants, a.nd climate-related shifts in prey species (Hayes et al. 2022). 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 Lease Area from May through November (LaBrecque et al. 2015).

## 4.2 Odontocetes

### *4.2.1 Atlantic White-Sided Dolphin (Langenorhynchus acutus)*

The Atlantic white-sided dolphin is robust and attains a body length of approximately 2.8 m (9 ft) (Jefferson et al. 2008). It is characterized by a strongly "keeled" tail stock and distinctive, white-sided color pattern ([BOEM] Bureau of Ocean Energy Management 2014). Atlantic white-sided dolphins form groups of varying sizes, ranging from a few individuals to over 500 (NMFS 2021k). They feed mostly on small schooling fishes, shrimps, and squids, and are often observed feeding in mixed-species groups with pilot whales and other dolphin species (Jefferson et al. 2008; 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).

#### *4.2.1.1 Distribution*

Atlantic white-sided dolphins migrate between the temperate and polar waters of the North Atlantic Ocean, but usually maintain migration routes over outer shelf or slope waters. This is 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 (Hayes et al. 2022). 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 Funday. And during fall, the distribution of the species is similar to that in summer, with less overall abundance (USDoN 2005). Behaviorally, this species is highly social, but not as demonstrative as some other common dolphins. They typically form pods of around 30 to 150 individuals but have also been seen in very large pods of 500 to 2,000 individuals (Hayes et al. 2020). It is common to find these pods associated with the presence of other white-beaked dolphins, pilot whales, fin whales, and humpback whales.

Kraus et al. (2016) suggest that Atlantic white-sided dolphins occur infrequently in the RI/MA and 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 the winter months, 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. Atlantic white-sided dolphins were seen during the spring and summer in the MA WEA and nearby waters during the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### *4.2.1.2 Abundance*

The best abundance estimate currently available for the Western North Atlantic stock is 93,233 based on surveys conducted between Labrador to Florida. A trend analysis is not currently available for this stock due to insufficient data.

#### *4.2.1.3 Status*

Atlantic white-sided dolphins are not listed under the ESA or considered a strategic stock under the MMPA. They are classified as Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The PBR for this stock is 544 and the annual rate of human-caused mortality and serious injury from 2015 to 2019 was estimated to be 27 dolphins (Hayes et al. 2022). This estimate is based on observed fishery interactions, but Atlantic white-sided dolphins are also threatened by contaminants in their habitat, and climate-related shifts in prey distribution (Hayes et al. 2022). There is no designated critical habitat for this stock in the Project Area.

### *4.2.2 Common Bottlenose Dolphin (Tursiops truncatus truncatus)*

Bottlenose Dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 2–4 m (6–12.5 ft) in length (NMFS 2021g). The snout is stocky and set off from the head by a crease. They are typically light to dark grey in color with a white underside (Jefferson et al. 1993). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NMFS 2021g). They 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 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).

#### 4.2.2.1 Distribution

In the Western North Atlantic, there are two morphologically and genetically distinct common bottlenose morphotypes, the Western North Atlantic Northern Migratory Coastal stock and the Western North Atlantic Offshore stock. 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 (Hayes et al. 2020), whereas the northern migratory coastal stock is distributed along the coast between southern Long Island, New York, and Florida (Hayes et al. 2018). Given their distribution, only the offshore stock is likely to occur in the Project Area and is the only stock included in this application. The western North Atlantic offshore stock is distributed primarily along the OCS and continental slope, from Georges Bank to Cape Hatteras during spring and summer. Between April 2020 and December 2021, there were 40 sightings of 614 individual common bottlenose dolphins recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC.

Kraus et al. (2016) observed common bottlenose dolphins during all seasons within the RI/MA and 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). Common bottlenose dolphins 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).

#### 4.2.2.2 Abundance

The best abundance estimate for the Western North Atlantic offshore stock is 62,851 based on recent surveys between the lower Bay of Fundy and Florida (Hayes et al. 2020). A population trend analysis for this stock was conducted using abundance estimates from 2004, 2011, and 2016, which show no statistically significant trend (Hayes et al. 2020).

#### 4.2.2.3 Status

Common bottlenose dolphins are not listed under the ESA and are classified as Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). The PBR for this stock is 519, and the average annual human-cause mortality and serious injury from 2013 to 2017 was estimated to be 28, attributed to fishery interactions (Hayes et al. 2020). Because annual mortality does not exceed PBR, this stock is not classified as strategic under the MMPA. In addition to fisheries, threats to common bottlenose dolphins include non-fishery related human interaction; anthropogenic noise; offshore development; contaminants in their habitat; and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for either stock in the Project Area.

### *4.2.3 Harbor Porpoise (Phocoena phocoena)*

This species is among the smallest of the toothed whales and is the only porpoise species found in Northeastern U.S. 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 (6 ft) and feeds on a wide variety of small fish and cephalopods (Reeves and Read 2003; Kenney and Vigness-Raposa 2010). Most harbor porpoise groups are small, usually between five and six individuals, although they aggregate into large 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 $\mathrm{SPL}_{\mathrm{rms}}$ (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).

#### *4.2.3.1 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 (Hayes et al. 2020). In the fall and spring, harbor porpoises are widely distributed from New Jersey to Maine (Hayes et al. 2020). 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 [5,906 ft]), although the majority of sightings are over the continental shelf (Hayes et al. 2020). Between April 2020 and December 2021, there was 1 sighting of 1 individual harbor porpoise recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC.

Kraus et al. (2016) indicate that harbor porpoises occur within the RI/MA and 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). Harbor porpoises were observed in the MA WEA and nearby waters during spring and fall of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### *4.2.3.2 Abundance*

The best available abundance estimate for the Gulf of Maine/Bay of Fundy stock occurring in the Project Area is 95,543 based on combined survey data from NOAA and the Department of Fisheries and Oceans Canada between the Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf and Central Virginia (Hayes et al. 2022). A population trend analysis is not available because data are insufficient for this species (Hayes et al. 2022).

#### *4.2.3.3 Status*

This species is not listed under the ESA and is considered non-strategic under the MMPA (Hayes et al. 2022). Harbor porpoise is listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this stock is 851, and the estimated human-caused annual mortality and serious injury from 2015 to 2019 was 164 harbor porpoises per year (Hayes et al. 2022). 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 (Hayes et al. 2022). Harbor porpoises also face threats from contaminants in their habitat, vessel traffic, habitat alteration due to offshore development, and climate-related shifts in prey distribution (Hayes et al. 2022). There is no designated critical habitat for this species near the Project Area.

### *4.2.4 Long-Finned Pilot Whale (Globicephala melas)*

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale and the short-finned pilot whale. These species are difficult to differentiate at sea and cannot be reliably distinguished during most surveys (Rone et al. 2012; Hayes et al. 2017). Both short-finned and long-finned pilot whales are similar in coloration and body shape. Pilot Whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 7.3 m (25 ft) in length (NMFS 2021e). 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). Pilot whales feed primarily on squid, although they also eat small to medium-sized fish and octopus when available (NMFS 2021e).

Like dolphin species, long-finned pilot whales can produce whistles and burst-pulses used for foraging and communication. Whistles typically range in frequency from 1 to 11 kHz while burst-pulses cover a broader frequency range from 100 Hz to 22 kHz (Erbe et al. 2017). Auditory evoked potential (AEP) measurements conducted by Pacini et al. (2010) indicate that the hearing sensitivity for this species ranges from <4 kHz to 89 kHz.

#### *4.2.4.1 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; Hayes et al. 2020). However, short-finned pilot whales are a southern or tropical species and pilot whale sightings above approximately 42° N are most likely long-finned pilot whales. Short-finned pilot whale occurrence in the Project Area is considered rare (CeTAP 1982; Hayes et al. 2020). Long-finned pilot whales are distributed along the continental shelf waters off the Northeastern U.S. 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 (Hayes et al. 2020). The two species' ranges overlap spatially along the shelf break between the southern flank of Georges Bank and New Jersey (Rone et al. 2012; Hayes et al. 2019).

Kraus et al. (2016) observed pilot whales infrequently in the RI/MA and 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). No pilot whales were observed in the MA WEA and nearby waters during the 2010–2017 AMAPPS surveys from 2010¬2017 (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### *4.2.4.2 Abundance*

The best available estimate of long-finned pilot whales in the Western North Atlantic is 39,215 based on recent surveys covering waters between Labrador and Central Virginia (Hayes et al. 2022). A trend analysis has not been conducted for this stock due to the relatively imprecise abundance estimates (Hayes et al. 2022).

#### *4.2.4.3 Status*

Long-finned pilot whales are not listed under the ESA and are classified as Least Concern by the IUCN Red List (Hayes et al. 2020; IUCN 2020). Long-finned pilot whales have a propensity to mass strand in U.S. waters, although the role of human activity in these strandings remains unknown (Hayes et al. 2022). The PBR for this stock is 306, and the annual human-caused mortality and serious injury was estimated to be 9 whales between 2015 and 2019 (Hayes et al. 2022). Threats to this population include entanglement in fishing gear, contaminants, climate-related shifts in prey distribution, and anthropogenic noise (Hayes et al. 2022). There is no designated critical habitat for this stock in the Project Area.

### *4.2.5 Risso's Dolphin (Grampus griseus)*

The Risso's Dolphin attains a body length of approximately 2.6–4 m (8.5–13 ft) (NMFS 2021c). Unlike most other dolphins, Risso's dolphins have blunt heads without distinct beaks. Coloration for this species ranges from dark to light grey. 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 2021c).

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).

#### *4.2.5.1 Distribution*

Risso's dolphins in the US Atlantic EEZ are part of the Western North Atlantic Stock. The Western North Atlantic stock of Risso's dolphins inhabits waters from Florida to eastern Newfoundland (Leatherwood et al. 1976; Baird and Stacey 1991). Off the Northeastern U.S. 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. 2020). 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 (Longhurst 1998; 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 RI/MA and 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 observed in the MA WEA and nearby waters during spring and summer of the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

#### *4.2.5.2 Abundance*

The best abundance estimate in the Western North Atlantic is 35,215 based on the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys (Hayes et al. 2022). A trend analysis was not conducted on this species, because there are insufficient data to generate this information.

#### *4.2.5.3 Status*

Risso's dolphins are not listed under the ESA and are classified as a species of Least Concern on the IUCN Red List (Hayes et al. 2020; IUCN 2020). PBR for this stock is 301, and the annual human-caused mortality and injury for 2015 to 2019 was estimated to be 34 (Hayes et al. 2022). 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, and climate-related shifts in prey distribution (Hayes et al. 2022). There is no designated critical habitat for this stock in the Project Area.

### *4.2.6 Short-Beaked Common Dolphin (Delphinus delphis delphis)*

Two common dolphin species were previously recognized: the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin (*Delphinus 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. Short-beaked common dolphins can reach 2.7 m (9 ft) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NMFS 2021j). This species feeds on schooling fish and squid found near the surface at night (NMFS 2021j). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NMFS 1993). This highly social and energetic species 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).

#### *4.2.6.1 Distribution*

Short-beaked 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 (Hayes et al. 2018). Short-beaked common dolphins are a highly seasonal, migratory species. In the US Atlantic EEZ this species is distributed along the continental shelf between the 200–2,000 m (650–6,561.6 ft) isobaths and is associated with Gulf Stream features (CeTAP 1982; Payne and Selzer 1989; Hamazaki 2002; Hayes et al. 2018). Short-beaked 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 (Payne and Selzer 1989; Hayes et al. 2020). Migration onto the Scotian Shelf and continental shelf off

Newfoundland occurs when water temperatures exceed 11°C (51.8°F) (Sergeant et al. 1970; Gowans and Whitehead 1995). Breeding usually takes place between the months of June and September and females have an estimated calving interval of two to three years (Hayes et al. 2018). Between April 2020 and December 2021, there were 230 sightings of 5,379 individual short-beaked common dolphins recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC.

Kraus et al. (2016) suggested that short-beaked common dolphins occur year-round in the RI/MA and 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. Short-beaked common dolphins were observed in the RI/MA and 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 short-beaked 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 short-beaked 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 short-beaked 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). Short-beaked common dolphins were 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).

#### *4.2.6.2 Abundance*

The best population estimate in the US Atlantic EEZ for the Western North Atlantic short-beaked common dolphin is 70,184 (Hayes et al. 2018) while Roberts et al. (2016) habitat-based density models provide an abundance estimate of 86,098 short-beaked common dolphins in the US Atlantic EEZ. The current best abundance estimate for the entire Western North Atlantic stock is 172,974 based on recent surveys conducted between Newfoundland and Florida (Hayes et al. 2020). A trend analysis was not conducted for this stock because of the imprecise abundance estimate and long survey intervals (Hayes et al. 2020).

#### *4.2.6.3 Status*

The common dolphin is not listed under the ESA and is classified as Least Concern by the IUCN Red List (Hayes et al. 2020; IUCN 2020). Historically, this species was hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from vessel collisions and Eastern North American fishing activities within the Atlantic, most prominently yellowfin tuna (*Thunnus albacares*) nets, driftnets, and bottom-set gillnets (Kraus et al. 2016; Hayes et al. 2020). 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 1,452 for this stock (Hayes et al. 2020). The annual estimated human-caused mortality and serious injury for 2015 to 2019 was 390.4, which included fishery-interactions and research takes (Hayes et al. 2022). Other threats to this species include contaminants in their habitat and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this stock in the Project Area.

### 4.2.7 Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest of all toothed whales; males can reach 16 m (52 ft) in length and weigh over 40,823 kilograms ("kg" [45 US tons]), and females can attain lengths of up to 11 m (36 ft) and weigh over 13,607 kg (15 tons) (Whitehead 2009). 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 frequently dive to depths of 400 m (1,300 ft) in search of their prey, which includes large squid, fishes, octopus, sharks, and skates (Whitehead 2009). This species can remain submerged for over an hour and reach depths as great as 1,000 m (3,280 ft). 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 2002; 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).

#### 4.2.7.1 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, where they prefer water depths of 600 m (1,969 ft) or more and are less common in waters <300 m (984 ft) deep (Waring et al. 2015; Hayes et al. 2020). 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 (Hayes et al. 2020). 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 (328-ft) isobath south of New England (Hayes et al. 2020). Sperm whale occurrence on the continental shelf in areas south of New England is at its highest in the fall (Hayes et al. 2020). Between April 2020 and December 2021, there was 1 sighting of 2 individual sperm whales recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC.

Kraus et al. (2016) observed sperm whales four times in the RI/MA and MA WEAs and surrounding areas in the summer and fall during the 2011–2015 NLPSC aerial survey. Sperm whales, traveling singly or in groups of three or four, were observed three times in August and September of 2012, and once in June of 2015. 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. Sperm whales were observed only once in the MA WEA and nearby waters during the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). This occurred during a summer shipboard survey in 2016.

### *4.2.7.2 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 and most recent abundance estimate based on 2016 surveys conducted between the lower Bay of Fundy and Florida is 4,349 (Hayes et al. 2020). No population trend analysis is available for this stock.

### *4.2.7.3 Status*

The Western North Atlantic stock is considered strategic under the MMPA due to its listing as Endangered under the ESA, and the global population is listed as Vulnerable on the IUCN Red List (Hayes et al. 2020; IUCN 2020). Between 2013 and 2017, 12 sperm whale strandings were documented along the U.S. East Coast, but none of the strandings showed evidence of human interactions (Hayes et al. 2020). A moratorium on sperm whale hunting was adopted in 1986 and currently no hunting is allowed for any purposes in the North Atlantic. Occasionally, sperm whales will become entangled in fishing gear or be struck by ships off the east coast of the U.S. However, this rate of mortality is not believed to have biologically significant impacts. The current PBR for this stock is 6.9, and because the total estimated human-caused mortality and serious injury is <10% of this calculated PBR, it is considered insignificant (Hayes et al. 2020). Other threats to sperm whales include contaminants, climate-related changes in prey distribution, and anthropogenic noise, although the severity of these threats on sperm whales is currently unknown (Hayes et al. 2020). There is no designated critical habitat for this population in the Project Area.

## 4.3 Pinnipeds

### *4.3.1 Gray Seal (Halichoerus grypus atlantica)*

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 (7.5–10 ft) in length, and have a silver-gray coat with scattered dark spots (NMFS 2021f). 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 (984 ft), 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 (Bonner et al. 1971; Reeves 1992; Jefferson et al. 2008). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NMFS 2021f).

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*

The eastern Canadian population of gray seals ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957; Mansfield 1966; Richardson and Rough 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). In US waters, gray seals currently pup at four established colonies from late December to mid-February: Muskeget and Monomoy Islands in Massachusetts, and Green and Seal Islands in Maine (Center for Coastal Studies 2017; Hayes et al. 2018). Pupping was also observed in the early 1980s on small islands in Nantucket-Vineyard Sound and more recently at Nomans Island (Hayes et al. 2018). Following the breeding season, gray seals may spend several weeks ashore in the late spring and early summer while undergoing a yearly molt. Between April 2020 and December 2021, there were 182 sightings of 231 individual gray seals recorded during HRG surveys within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC (Milne 2021, 2022).

Kraus et al. (2016) observed gray seals in the RI/MA and 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. 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*

Estimates of the entire Western North Atlantic gray seal population are not available. Some estimates are available for portions of the stock, although recent genetic evidence suggests that all Western North Atlantic gray seals may actually comprise a single stock (Hayes et al. 2020). The best available current abundance estimate for gray seals of the Canadian gray seal stock is 424,300 and the current U.S. population estimate is 27,300 (Hayes et al. 2022). The population of gray seals is likely increasing in the U.S. Atlantic EEZ; recent data show approximately 28,000 to 40,000 gray seals were observed in Southeastern Massachusetts in 2015 (Hayes et al. 2020). A population trend is not currently available for this stock, although the observed increase in the number of pups born in U.S. pupping colonies between 1991 and 2019 is currently being evaluated (Hayes et al. 2020).

#### *4.3.1.3 Status*

This species is not listed under the ESA and is non-strategic under the MMPA because anthropogenic mortality does not exceed PBR (Hayes et al. 2020). Gray seal is listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this population is 1,458, and the annual human-caused mortality and serious injury between 2015 and 2019 was estimated to be 4,453 in both the U.S. and Canada (Hayes et al. 2022). Like harbor seals, the gray seal was commercially and recreationally hunted until 1972. Mortality is currently attributed to fishery interactions, non-fishery related human interactions and hunting, research activities, Canadian commercial harvest, and removals of nuisance animals in Canada (Hayes et al. 2020). Other threats to this population include disease, predation, and natural phenomena like storms (Hayes et al. 2020). There is no designated critical habitat for this species in the Project Area.

### *4.3.2 Harbor Seal (Phoca vitulina vitulina)*

The harbor seal is one of the smaller pinnipeds, and adults are often light to dark grey 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 (6 ft) in length (NMFS 2021b). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Harbor seals consumes a variety of prey, including fish, shellfish, and crustaceans (Bigg 1981; Reeves 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 2 sec and a peak frequency between 1 and 2 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. 2018). 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. 2020). 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 (U.S. Department of the Navy) 2005; Hayes et al. 2020). 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). Between April 2020 and December 2021, there were 15 sightings of 15 individual harbor seals recorded during HRG surveys conducted within the area surrounding the SouthCoast Wind Lease Area and Falmouth ECC (Milne 2021, 2022).

Kraus et al. (2016) observed harbor seals in the RI/MA and 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 RI/MA and 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). 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).

#### *4.3.2.2 Abundance*

The best available abundance estimate for harbor seals in the Western North Atlantic is 61,336, with global population estimates reaching 610,000 to 640,000. 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). Trend in population from 1993 to 2018 was estimated for non-pups and pups 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 a 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, are listed as Least Concern by the IUCN Red List and are considered non-strategic because anthropogenic mortality does not exceed PBR (Hayes et al. 2020; IUCN 2020). 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. 2020). Until 1972, harbor seals were commercially and recreationally hunted. Currently, only Alaska natives can hunt harbor seals for sustenance and the creation of authentic handicrafts. Other threats to harbor seals include disease and predation (Hayes et al. 2020). There is no designated critical habitat for this species in the Project Area.

# 5 Type of Incidental Take Authorization Requested

SouthCoast Wind is requesting the promulgation of incidental take regulations and issuance of a Letter of Authorization 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 the OCS-A 0521 Lease Area and along the proposed ECCs to Falmouth, MA and Somerset, MA (Figure 1).

The construction and operations activities have the potential to take marine mammals as a result of sound energy introduced to the marine environment. Sounds that may “harass” marine mammals include pulsed sounds generated by impact pile driving, HRG survey equipment, and potential UXO detonation as well as continuous sounds generated by vibratory pile driving. The potential effects will depend on the species of marine mammal, the behavior of the animal at the time of reception of the stimulus, as well as the received level (RL) of the sound. Disturbance reactions are likely to vary among some of the marine mammals in the general vicinity of the sound source. The mitigation and monitoring activities described in Section 11, including a combination of noise attenuation systems and advanced monitoring technologies such as passive acoustic recorders, infrared cameras, and night vision devices will be implemented so that the amount of Level B take is reduced to the lowest practicable level. Conducting installation activities at any time of day or night will increase the amount of activity completed during the time of year when NARW have the lowest presence in the Project Area, thereby reducing overall impacts to this species.

Certain construction activities, including WTG and OSP monopile foundation installation (impact pile driving) and UXO detonation, have a small chance of causing Level A "take" for some marine mammal species. The planned monitoring and mitigation measures will reduce, but cannot eliminate, this possibility. Therefore, Level A takes are also requested as described below.

# 6 Take Estimates for Marine Mammals

Nearly all anticipated takes would be "takes by harassment", involving temporary changes in behavior (i.e., Level B harassment). Specifically, acoustic exposure could result in temporary displacement of marine mammals from within ensonified zones or other temporary changes in behavioral state. The mitigation measures to be applied will reduce the already very low probability of Level A take, but for certain species and activities, some potential Level A takes could occur. The planned construction and operations 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. In the sections below, we describe the methods used to calculate potential take and present the resulting request for take authorization.

## 6.1 Basis for Estimating Potential "Take"

In this section, three different methods are used to estimate the potential take of marine mammal species or stocks. The results of the three methods are then compared for each species or stock and the largest take estimate is used as the requested take. The first method involves using marine mammal density data and estimates of the area ensonified above threshold levels, performed with or without the use of animal exposure modeling (depending on the activity, details provided below), to calculate a density-based take estimate. The second method uses PSO observations from surveys conducted in and around the Project Area to calculate a daily sighting rate for each species. This daily sighting rate is then used to estimate the number of potential takes based on the number of days on which each activity is expected to produce sounds above the threshold levels. Finally, the third method is applicable to less common species and simply uses the average group size from available survey data in the region to calculate the number of individuals likely to be encountered, should the species be observed near the planned activities.

### *6.1.1 Density-based Take Estimate Methods*

Density-based estimates of potential take calculated in two separate ways, depending on the activity. For WTG and OSP foundation installations, sound exposure modeling was conducted to more accurately account for the movement and behavior of marine mammals and their exposure to the underwater sound fields produced during pile driving. Sound exposure modeling involves the use of a three-dimensional computer simulation in which simulated animals (animats) move through the modeled marine environment over time in ways that are defined by the known or assumed movement patterns for each species derived from visual observation, animal borne tag, or other similar studies. The sound field produced by the activity, in this case impact and/or vibratory pile driving, is then added to the modeling environment at the location and for the duration of time anticipated for one or more pile installations. At each time step in the simulation, each animat records the received sound levels at its location resulting in a sound exposure history for each animat. These exposure histories are then analyzed to determine whether and how many animats were exposed above Level A and Level B thresholds. Finally, the density of animats used in the modeling environment, which is usually much higher than the actual density of marine mammals in the activity area so that the results are more statistically robust, is compared to the actual density of marine mammals anticipated to be in the activity area. The results are then used to scale the animat exposure estimates to the actual density estimates. A more detailed description of this method is available in Appendix A, including results for some species if avoidance of anthropogenic sounds (aversion) is included in the exposure modeling. However, the exposure modeling results including aversion are not used in the estimates of potential take included in this application.

For HRG surveys and potential UXO detonations, takes are calculated by multiplying the expected densities of marine mammals in the activity area(s) by the area of water likely to be ensonified above the NMFS defined threshold levels in a single day (24-hour period). The result is then multiplied by the number of days on which the activity is expected to occur resulting in a density-based estimated take for each activity.

For the sound exposure modeling density-based take calculations, the densities of marine mammals (individuals per unit area) expected to occur in the activity areas were calculated from habitat-based density modeling results reported by Roberts et al. (2016; 2023) (Table 6). Those data provide density estimates for species or species guilds within 5 km x 5 km (3 mi x 3 mi) grid cells on a monthly or annual basis, depending on the species. The average monthly density for each species in each activity area was calculated as the unweighted mean of the grid cells within each activity area in each month. The grid cells used for the density calculations of each activity area are described separately in the activity-specific sections below.

The estimated monthly density of seals provided in Roberts et al. (2016; 2023) includes all seal species present in the region as a single guild. To split the resulting "seal" density estimate by species, we multiplied the estimate by the proportion of each species observed by PSOs during SouthCoast Wind's 2020–2021 site characterization surveys (Milne 2021, 2022). The proportions used were 231/246 (0.939) for gray seals and 15/246 (0.061) for harbor seals. The "seal" density provide by Roberts et al. (2016; 2023) was then multiplied by these proportions to get the species specific densities. While the Roberts et al. (2016; 2023) seals guild includes all phocid seals, due to a lack of sightings of harp seals during site characterization surveys SouthCoast Wind is not requesting take for this species and thus they were not included in the splitting of the seals guild density.

Table 6. Marine Mammal density model version number, release date, and report citation for densities used in density-based calculations.

| Species | Scientific Name | Density Model Version Used | Model Release Date | Report Citation |
|---|---|---|---|---|
| ***Mysticetes*** | | | | |
| Blue Whale* | *Balaenopter musculus* | 2 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Fin Whale* | *Balaenoptera physalus* | 12 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Humpback Whale | *Megaptera novaeangliae* | 11 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Minke Whale | *Balaenoptera acutorostrata* | 10 | 06-20-2022 | Roberts et al. 2016; 2023 |
| North Atlantic Right Whale* | *Eubalaena glacialis* | 12 | 06-20-2022 | Roberts et al. 2016; 2023 |

| | | | | |
|---|---|---|---|---|
| Sei Whale* | *Balaenoptera borealis* | 10 | 06-20-2022 | Roberts et al. 2016; 2023 |
| ***Odontocetes*** | | | | |
| Atlantic Spotted Dolphin | *Stenella frontalis* | 9 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Atlantic White-Sided Dolphin | *Lagenorhynchus acutus* | 4 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Bottlenose Dolphin | *Tursiops truncatus* | 6 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Common Dolphin | *Delphinus delphis* | 5 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Harbor Porpoise | *Phocoena phocoena* | 6 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Pilot Whales | *Globicephala* spp. | 7 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Risso's Dolphin | *Grampus griseus* | 5 | 06-20-2022 | Roberts et al. 2016; 2023 |
| Sperm Whale* | *Physeter macrocephalus* | 8 | 06-20-2022 | Roberts et al. 2016; 2023 |
| ***Pinnipeds*** | | | | |
| Seals (Harbor and Gray) | *Phocidae* spp. | 5 | 06-20-2022 | Roberts et al. 2016; 2023 |

* Denotes species listed under the Endangered Species Act

### *6.1.2 PSO Data Take Estimate Methods*

For some species, observational data from Protected Species Observers (PSOs) aboard HRG and survey vessels indicate that the 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, the PSO data are used as described here to calculate a daily encounter rate for comparison with the density-based estimates of take.

PSO data from HRG surveys conducted in and around the Lease Area and ECCs from April 2020 through December 2021 were analyzed to determine the average number of individuals of each species observed per vessel day. 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 of Species Within Each Species Group" within Table 7. The proportion of each species was then multiplied by the total number of "unidentified" individuals belonging to that taxonomic group so that the unassigned individuals were re-assigned to the identified species proportional to the identified individuals within each taxonomic as shown in the column "Unidentified Individuals Assigned to Species" column in Table 7. The identified and re-assigned unidentified individuals for each species was then summed as shown in the "Total Individuals Including Proportion of Unidentified" column of Table 7. This value was then divided by the number of vessel days during which observations were conducted during 2020-2021 HRG surveys (555 days) to calculate the number of individuals observed per vessel day as shown in the final column in Table 7.

Table 7. The number of individual marine mammals observed, with and without inclusion of unidentified individuals, and the estimated number of individuals observed per vessel day during HRG surveys from April 2020 – December 2021.

| 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 |
|---|---|---|---|---|---|
| ***Mysticetes*** | **295** | | | | |
| Blue Whale* | 0 | - | - | - | - |
| Fin Whale* | 23 | 0.08 | 3.27 | 26.27 | 0.05 |
| Humpback Whale | 222 | 0.75 | 31.61 | 253.61 | 0.46 |
| Minke Whale | 44 | 0.15 | 6.26 | 50.26 | 0.09 |
| North Atlantic Right Whale* | 0 | - | - | - | - |
| Sei Whale* | 6 | 0.02 | 0.85 | 6.85 | 0.01 |
| ***Unidentified Mysticetes*** | **42** | | | | |
| Unidentified Baleen Whale | 16 | | | | |
| Unidentified Whale | 26 | | | | - |
| ***Odontocetes*** | **6010** | | | | |
| Atlantic Spotted Dolphin | 0 | - | - | - | - |
| Atlantic White-Sided Dolphin | 0 | - | - | - | - |
| Bottlenose Dolphin | 614 | 0.10 | 43.93 | 657.93 | 1.19 |
| Common Dolphin | 5366 | 0.89 | 383.92 | 5749.92 | 10.36 |
| Harbor Porpoise | 1 | 0.00 | 0.07 | 1.07 | 0.00 |
| Pilot Whales | 27 | 0.00 | 1.93 | 28.93 | 0.05 |
| Risso's Dolphin | 0 | - | - | - | - |
| Sperm Whale* | 2 | 0.00 | 0.14 | 2.14 | 0.00 |
| ***Unidentified Odontocetes*** | **430** | | | | |
| Unidentified Dolphin | 430 | | | | - |
| ***Pinnipeds*** | **246** | | | | |
| Harbor Seal | 15 | 0.06 | 0.49 | 15.49 | 0.03 |
| Gray Seal | 231 | 0.94 | 7.51 | 238.51 | 0.43 |
| ***Unidentified Pinniped*** | **8** | | | | |
| Unidentified Pinniped | 8 | | | | |

* Denotes species listed under the Endangered Species Act

### *6.1.3 Mean Group Size Take Estimate Methods*

For other less-common species, the predicted densities from Roberts et al. (2016; 2023) are very low and the resulting density-based take estimate is less than a single animal or a typical group size for the species. In such cases, the density-based take estimate is increased to the mean group size for the species to account for a chance encounter during an activity. Mean group sizes for each species were calculated from recent aerial and/or vessel-based surveys as shown in Table 8. Group size data are from

NLPSC aerial surveys of the RI/MA WEAs during 2011–2015 (Kraus et al. 2016) and AMAPPS surveys from 2010–2019 (Palka et al. 2017; Palka et al. 2021).

Table 8. Mean group sizes of species for which incidental take is being requested.

| Species | Individuals | Sightings | Mean Group Size | Source |
|---|---|---|---|---|
| ***Mysticetes*** | | | | |
| Blue Whale* | 15 | 14 | 1.0 | 2010-2021 AMAPPS† |
| Fin Whale* | 155 | 86 | 1.8 | Kraus et al. (2016) |
| Humpback Whale | 160 | 82 | 2.0 | Kraus et al. (2016) |
| Minke Whale | - | - | 1.4 | Palka et al. (2021) |
| North Atlantic Right Whale* | 145 | 60 | 2.4 | Kraus et al. (2016) |
| Sei Whale* | 41 | 25 | 1.6 | Kraus et al. (2016) |
| ***Odontocetes*** | | | | |
| Atlantic Spotted Dolphin | 1334 | 46 | 29.0 | Palka et al. (2017) |
| Atlantic White-Sided Dolphin | 223 | 8 | 27.9 | Kraus et al. (2016) |
| Bottlenose Dolphin | - | - | 12.3 | Palka et al. (2021) |
| Common Dolphin | 2,896 | 83 | 34.9 | Kraus et al. (2016) |
| Harbor Porpoise | 121 | 45 | 2.7 | Kraus et al. (2016) |
| Pilot Whales | - | - | 10.3 | Palka et al. (2021) |
| Risso's Dolphin | 1215 | 224 | 5.4 | Palka et al. (2017) |
| Sperm Whale* | - | - | 2.0 | Palka et al. (2021) |
| ***Pinnipeds*** | | | | |
| Seals (Harbor and Gray) | 201 | 144 | 1.4 | Palka et al. (2017) |

* Denotes species listed under the Endangered Species Act.

† Data extracted from 2010-2021 AMAPPS reports (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022)

## 6.2 Acoustic Thresholds

To assess potential auditory injury or permanent threshold shift (PTS), Level A harassment, NMFS has provided technical guidance ([NMFS] National Marine Fisheries Service 2018) that establishes dual criteria for five different marine mammal hearing groups, four of which occur in the Lease Area (Table 9). 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 9. 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 strong, 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).

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 effectively filter out sound energy at frequencies of less importance to species. Frequency weighting is applied when calculating distances to the $\mathrm{SEL}_{\mathrm{cum}}$ threshold and some behavioral thresholds while $\mathrm{SPL}_{\mathrm{pk}}$ is not frequency weighted, which is commonly referred to as unweighted or flat-weighted (Table 9).

Table 9. Marine mammal functional hearing groups and PTS (Level A harassment) and TTS thresholds as defined by NMFS (2018) for species present in the Project Area.

| Marine Mammal Hearing Group | Generalized Hearing Range | PTS onset (Level A) Thresholds (Impulsive Sounds) | TTS onset Thresholds (Impulsive Sounds) |
|---|---|---|---|
| Low-frequency cetaceans (LF) | 7 Hz to 35 kHz | $L_{\mathrm{pk,flat}}$: 219 dB<br>$L_{\mathrm{E,LF,24h}}$: 183 dB | $L_{\mathrm{pk,flat}}$: 213 dB<br>$L_{\mathrm{E,LF,24h}}$: 168 dB |
| Mid-frequency cetaceans (MF) | 150 Hz to 160 kHz | $L_{\mathrm{pk,flat}}$: 230 dB<br>$L_{\mathrm{E,LF,24h}}$: 185 dB | $L_{\mathrm{pk,flat}}$: 224 dB<br>$L_{\mathrm{E,LF,24h}}$: 170 dB |
| High-frequency cetaceans (HF) | 275 Hz to 160 kHz | $L_{\mathrm{pk,flat}}$: 202 dB<br>$L_{\mathrm{E,LF,24h}}$: 155 dB | $L_{\mathrm{pk,flat}}$: 196 dB<br>$L_{\mathrm{E,LF,24h}}$: 140 dB |
| Phocid pinnipeds (underwater) (PW) | 50 Hz to 86 kHz | $L_{\mathrm{pk,flat}}$: 218 dB<br>$L_{\mathrm{E,LF,24h}}$: 185 dB | $L_{\mathrm{pk,flat}}$: 212 dB<br>$L_{\mathrm{E,LF,24h}}$: 170 dB |

Scientific recommendations for revisions to these classifications were recently 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). The hearing groups and nomenclature proposed by Southall et al. (2019) have not yet been incorporated into the NMFS guidelines.

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. 2007b; 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 $\mathrm{SPL}_{\mathrm{rms}}$ [unless otherwise noted, all dB values are referenced to 1 µPa] for impulsive or intermittent sounds such as those produced by impact pile driving and some HRG survey equipment. For non-impulsive sounds, such as vibratory pile driving, NMFS defines the threshold for behavioral harassment at 120 dB re 1 µPa $\mathrm{SPL}_{\mathrm{rms}}$.

In the case of potential UXO detonations, additional 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 (U.S. Department of the Navy) 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 10). The results from the equations in Table 10 were used in the subsequent analyses.

Table 10. 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 (U.S. Department of the Navy) 2017). M is animal mass (in kg) and D is animal depth (m).

| Onset Effect for Mitigation Consideration | Threshold |
|---|---|
| Onset Mortality- Impulse | $103M^{1/3}(1+\frac{D}{10.1})^{1/6}$ Pa-s |
| Onset Injury- Impulse (Non-auditory) | $47.5M^{1/3}(1+\frac{D}{10.1})^{1/6}$ Pa-s |
| Onset Injury- Peak Pressure (Non-auditory) | 237 dB re 1 μPa peak |

A single UXO/MEC detonation per day is not considered to cause behavioral harassment at the 160 dB level noted above. Instead, Level B harassment is considered possible if received sounds from a single UXO/MEC detonation per day rise above temporary threshold shift (TTS) levels or above 5 dB below the TTS thresholds in the event of multiple detonations in one day. Since only a single detonation per day is being considered, sub-TTS threshold behavioral harassment is not expected to occur. As with PTS onset levels used to define Level A take thresholds, TTS criteria use both $SPL_{pk}$ and $SEL_{cum}$ criteria as shown Table 9.

## 6.3 WTG and OSP Foundation Installation

As described in Section 1, three types of foundations are under consideration for the WTGs and OSPs. The monopile and piled jacket foundation types would involve impact and/or vibratory pile driving and potentially cause take through the introduction of sound into the marine environment. The suction-bucket foundations would not involve the use of pile driving or other significant sources of sound that may cause take, so they are not considered further in this section. To assess the potential level of take from impact and/or vibratory pile driving for installation of WTG and OSP foundations, acoustic and animal exposure modeling was performed for several different construction scenarios developed using different sets of assumptions. Due to concerns around pile driving in the vicinity of the Nantucket Shoals area and the larger ensonified area associated with vibratory piling, no vibratory pile driving is planned for foundation installation for the construction of Project 1 (Year 1). Either monopiles or piled jackets will be used for the WTG foundations, but only piled jackets for OSP foundations.

The current best estimate is that foundation installations will occur across approximately 6 months in a given year. Under ideal conditions installations could be completed in fewer months, but it is also possible that it will require more than 6 months to complete the installations. In creating the installation schedules used for estimating take, the total number of installations was spread across all potential months in which they might occur in order to incorporate the month-to-month variability in species presence and account for potential installations in all proposed months. We believe this provides a realistic estimate of take across all species and is likely conservative for key species. For example, inclusion of installations in May, November, and December results in higher estimated takes for right whales compared to assuming a more compressed schedule in lower density months.

Animal movement (exposure) modeling was conducted to provide exposure estimates for WTG and OSP foundation installation for the Projects. The detailed methodology and results of this modeling are included in Appendix A. Seven-day simulations are run for each combination of species, foundation type, number installed per day, season, modeling location, sound source, and sound attenuation level.

During the simulation, the modeled animals (i.e., 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. The result is a 24-hour sound exposure profile for each animat for seven days. In model post-processing, the seven-day average number of animats exceeding each sound exposure threshold is then calculated for each simulation. Monthly marine mammal densities, which 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, are then applied to this seven-day average 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 installation schedules (see below). Finally, the monthly exposures are summed to obtain modeled exposure estimates for each species and for each potential installation schedule, which is the final result of the exposure modeling (see Section 4.3 of Appendix A).

The primary assumptions used in the modeling for each year of construction are summarized in Table 11 and listed below. Year 1 assumes WTG foundation installations will use impact pile driving only. Year 2 assumes WTG foundation installations will use either a combination of vibratory and impact pile driving or impact pile driving only. The modeling assumes that WTG foundation installation will progress in a sequential manner, whereby one foundation is installed completely before installation of the next foundation begins. For jacket foundations, the jacket piles are installed sequentially and all piles for a single foundation are installed before installation of the next foundation begins. The modeling also includes concurrent installation of WTG foundations and OSP foundations whereby installation of the two foundation types occurs at the same time. For these cases, only impact pile driving was assumed. Modeling was conducted assuming installation from May through December. SouthCoast Wind does not intend to conduct pile driving activity from January 1 through May 14 each year.

1. Year 1 – WTG monopiles or WTG piled jackets, impact piling only with concurrent OSP installations
    a. Scenario 1 - Sequential installation of 68 WTG monopile foundations (9/16 m; assuming 1 pile per day for 44 of the monopiles and 2 piles per day for 24 of the monopiles) plus concurrent installation of OSP jacket (12, 4.5 m pin piles) and 3 WTG monopile (1/day) foundations (Table 12), for a total of 71 WTG monopiles and 1 OSP jacket foundation.
    b. Scenario 2 - Sequential installation of 81 WTG jacket foundations (1 jacket per day with 4, 4.5 m pin piles per jacket) plus concurrent installation of OSP jacket (16, 4.5 m pin piles) and 4 WTG jacket (1 jacket per day with 4, 4.5 m pin piles per jacket) foundations (Table 13), for a total of 85 WTG jacket foundations and 1 OSP jacket foundation.
2. Year 2 – WTG monopiles or WTG piled jackets, vibratory and impact piling with concurrent OSP installations
    a. Scenario 1 - Sequential installation of 65 WTG monopile foundations (9/16 m; assuming 1 pile per day for 35 of the monopiles and 2 piles per day for 30 of the monopiles) plus concurrent installation of OSP jacket (12, 4.5 m pin piles) and 3 WTG monopile (9/16 m; 1/day) foundations, all using only impact pile driving (Table 14), for a total of 68 WTG monopiles and 1 OSP jacket foundation.
    b. Scenario 2 – Sequential installation of 67 WTG monopile foundations (9/16 m; assuming 1 pile per day for 19 monopiles and 2 piles per day for 48 of the monopiles) using

vibratory and impact piling plus concurrent installation of OSP jacket (12, 4.5 m pin piles) and 3 WTG monopile (9/16 m; 1/day) foundations using only impact pile driving, as well as 3 WTG monopile foundations (9/16 m; assuming 1 pile per day) using only impact pile driving (Table 15), for a total of 73 WTG monopiles and 1 OSP jacket foundation.

c. Scenario 3 - Sequential installation of 48 WTG jacket foundations (1 jacket per day with 4, 4.5 m pin piles per jacket) using vibratory and impact piling and 10 WTG jacket foundations using only impact pile driving (1 jacket per day with 4, 4.5 m pin piles per jacket) plus concurrent installation of OSP jacket (16, 4.5 m pin piles per jacket) and 4 WTG jacket (4, 4.5 m pin piles per jacket) foundations using only impact pile driving (Table 16), for a total of 62 WTG jacket foundations and 1 OSP jacket foundation.

Each of the scenarios included an assumed distribution of installation days per month (Table 12 through Table 16). Additional details regarding the modeling and associated assumptions are available in Appendix A, including some Year 1 installation scenarios that were part of the modeling process but have been intentionally left out of this application because they included vibratory pile driving.

Table 11. Assumptions used in WTG and OSP foundation installation by year for which acoustic and sound exposure modeling was conducted to estimate potential incidental take of marine mammals.

| | **Year 1** | | | **Year 2** | | | |
|---|---|---|---|---|---|---|---|
| | WTG Monopiles (Scenario 1) | WTG Jackets (Scenario 2) | OSP Jackets | WTG Monopiles (Scenario 1) | WTG Monopiles (Scenario 2) | WTG Jackets (Scenario 3) | OSP Jackets |
| Foundations | 71 | 85 | 1 | 68 | 73 | 62 | 1 |
| Piles per foundation | 1 | 4 | 12-16 | 1 | 1 | 4 | 12-16 |
| Pile Diameter (m) | 9/16 | 4.5 | 4.5 | 9/16 | 9/16 | 4.5 | 4.5 |
| Target Penetration Depth (m) | 35 | 60 | 60 | 35 | 35 | 60 | 60 |
| Maximum Hammer Energy (kJ)[1] | 6600 | 3500 | 3500 | 6600 | 6600 | 3500 | 3500 |
| Impact or Vibratory | Impact | Impact | Impact | Impact | Both | Both | Impact |
| Impact piling strikes per pile[1] | 7000 | 4000 / NA | 4000 | 7000 | 7000 / 5000 | 4000 / 2667 | 4000 |
| Piles Per Day | 1 or 2 | 4 | 4 | 1 or 2 | 1 or 2 | 4 | 4 |
| Total Pile Installation Days | 59 | 85 | 3/4 | 53 | 49 | 62 | 3/4 |
| Installation Years | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Installation Months | May – Dec | May – Dec | Oct | May – Dec | May – Dec | May – Dec | Oct |

[1] The acoustic modeling assumed the maximum hammer energy was used for all strikes (Appendix A, Tables 1–4).

[2] The first value shows the number of strikes if only impact pile driving is used while the second value shows the number of strikes if both vibratory and impact pile driving are used. For Year 1, even though a vibratory plus impact scenario was modeled this is not applicable (NA) because vibratory piling is no longer being considered in Year 1.

Table 12. Installation schedule (assumed days of piling per month) for Year 1 – Scenario 1 for installing WTG monopile and OSP jacket foundations using impact pile driving only.

| | **Vibratory & Impact** | | **Concurrent Impact** | **Impact Only** | | **Totals** | |
|---|---|---|---|---|---|---|---|
| | WTG monopile | | WTG monopile & OSP jacket | WTG monopile | | Total number of piles | Total number of days |
| **Month** | 2 piles per day | 1 pile per day | 1 pile per day & 4 piles per day | 2 piles per day | 1 pile per day | | |
| May | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| June | 0 | 0 | 0 | 1 | 8 | 10 | 9 |
| July | 0 | 0 | 0 | 3 | 10 | 16 | 13 |
| August | 0 | 0 | 0 | 4 | 10 | 18 | 14 |
| September | 0 | 0 | 0 | 3 | 9 | 15 | 12 |
| October | 0 | 0 | 3 | 1 | 3 | 20 | 7 |
| November | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| December | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Total** | **0** | **0** | **3** | **12** | **44** | **83** | **59** |

Table 13. Installation schedule (days of piling per month) for Year 1 – Scenario 2 for installing WTG jacket and OSP jacket foundations using impact pile driving only.

| | **Vibratory & Impact** | **Concurrent Impact** | **Impact Only** | **Totals** | |
|---|---|---|---|---|---|
| | WTG jacket | WTG jacket & OSP jacket | WTG jacket | Total number of piles | Total number of days |
| **Month** | 4 piles per day | 4 piles per day & 4 piles per day | 4 piles per day | | |
| May | 0 | 0 | 8 | 32 | 8 |
| June | 0 | 0 | 10 | 40 | 10 |
| July | 0 | 0 | 12 | 48 | 12 |
| August | 0 | 0 | 14 | 56 | 14 |
| September | 0 | 0 | 12 | 48 | 12 |
| October | 0 | 4 | 12 | 80 | 16 |
| November | 0 | 0 | 10 | 40 | 10 |
| December | 0 | 0 | 3 | 12 | 3 |
| **Total** | **0** | **4** | **81** | **356** | **85** |

Table 14. Installation schedule (days of piling per month) for Year 2 – Scenario 1 for installing WTG monopile and OSP jacket foundations using impact pile driving only.

| | **Vibratory & Impact** | | **Concurrent Impact** | **Impact Only** | | **Totals** | |
|---|---|---|---|---|---|---|---|
| | WTG monopile | | WTG monopile & OSP jacket | WTG monopile | | Total number of piles | Total number of days |
| **Month** | 2 piles per day | 1 pile per day | 1 per day & 4 piles per day | 2 piles per day | 1 pile per day | | |
| May | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| June | 0 | 0 | 0 | 3 | 6 | 12 | 9 |
| July | 0 | 0 | 0 | 3 | 6 | 12 | 9 |
| August | 0 | 0 | 0 | 3 | 6 | 12 | 9 |
| September | 0 | 0 | 0 | 3 | 6 | 12 | 9 |
| October | 0 | 0 | 3 | 3 | 6 | 27 | 12 |
| November | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| December | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Total** | **0** | **0** | **3** | **15** | **35** | **80** | **53** |

Table 15. Installation schedule (days of piling per month) for Year 2 – Scenario 2 for installing WTG monopile and OSP jacket foundations using impact and vibratory pile driving.

| | Vibratory & Impact | | Concurrent Impact | Impact Only | | Totals | |
|---|---|---|---|---|---|---|---|
| | WTG monopile | | WTG monopile & OSP jacket | WTG monopile | | Total number of piles | Total number of days |
| **Month** | 2 piles per day | 1 pile per day | 1 per day & 4 piles per day | 2 piles per day | 1 pile per day | | |
| May | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| June | 2 | 4 | 0 | 0 | 0 | 8 | 6 |
| July | 6 | 4 | 0 | 0 | 0 | 16 | 10 |
| August | 7 | 4 | 0 | 0 | 0 | 18 | 11 |
| September | 6 | 4 | 0 | 0 | 0 | 16 | 10 |
| October | 3 | 2 | 3 | 0 | 0 | 23 | 8 |
| November | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| December | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| **Total** | **24** | **19** | **3** | **0** | **3** | **85** | **49** |

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Table 16. Installation schedule (days of piling per month) for Year 2 – Scenario 3 for installing WTG jacket and OSP jacket foundations using impact and vibratory pile driving.

| | Vibratory & Impact | Concurrent Impact | Impact Only | Totals | |
|---|---|---|---|---|---|
| | WTG jacket | WTG jacket & OSP jacket | WTG jacket | Total number of piles | Total number of days |
| **Month** | 4 piles per day | 4 piles per day & 4 piles per day | 4 piles per day | | |
| May | 0 | 0 | 5 | 20 | 5 |
| June | 9 | 0 | 0 | 36 | 9 |
| July | 9 | 0 | 0 | 36 | 9 |
| August | 9 | 0 | 0 | 36 | 9 |
| September | 9 | 0 | 0 | 36 | 9 |
| October | 6 | 4 | 0 | 56 | 10 |
| November | 6 | 0 | 0 | 24 | 6 |
| December | 0 | 0 | 5 | 20 | 5 |
| **Total** | **48** | **4** | **10** | **264** | **62** |

### *6.3.1 Marine Mammal Densities*

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 6.3 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 per month is based on the proposed installation schedules as shown in Tables 12–16. These are then summed to obtain modeled exposure estimates for each species and for each potential installation schedule, which is the final result of the exposure modeling (see Section 4.3 of Appendix A). Additional details of how exposure estimates are obtained using density data can be found in Appendix A.

Marine mammal density data used to calculate mean monthly densities in the exposure modeling were selected from Roberts et al. (2016; 2023) and the distance around the perimeter of the Lease Area within which densities were calculated was based on the $ER_{95\%}$ ranges for the scenario being modeled (see Appendix A Section 3.2). As described in Appendix A, the model used densities calculated for eight preselected ranges of 1, 5, 10, 15, 20, 30, 40, and 50 km. The densities obtained using a 10-km perimeter are shown, as an example, in Table 17. Densities for the other seven perimeter sizes can be found in Tables H-3 through H-9 of Appendix A. For each different species, scenario (e.g., foundation type, number of piles per day, season, concurrent/sequential, vibratory/impact), attenuation level, and threshold (e.g., $SPL_{rms}$ or $SEL_{cum}$), the model selects the most appropriate perimeter as the next highest preselected perimeter greater than the $ER_{95\%}$ for that combination of species, threshold, foundation type, etc. For example, if the $ER_{95\%}$ was 8.5 km, the 10 km buffer would be used. Figure 10 shows an example of how a 5-km buffer is used to select density grid cells and Table 17 shows an example of marine mammal monthly densities within 10 km of the Lease Area perimeter.

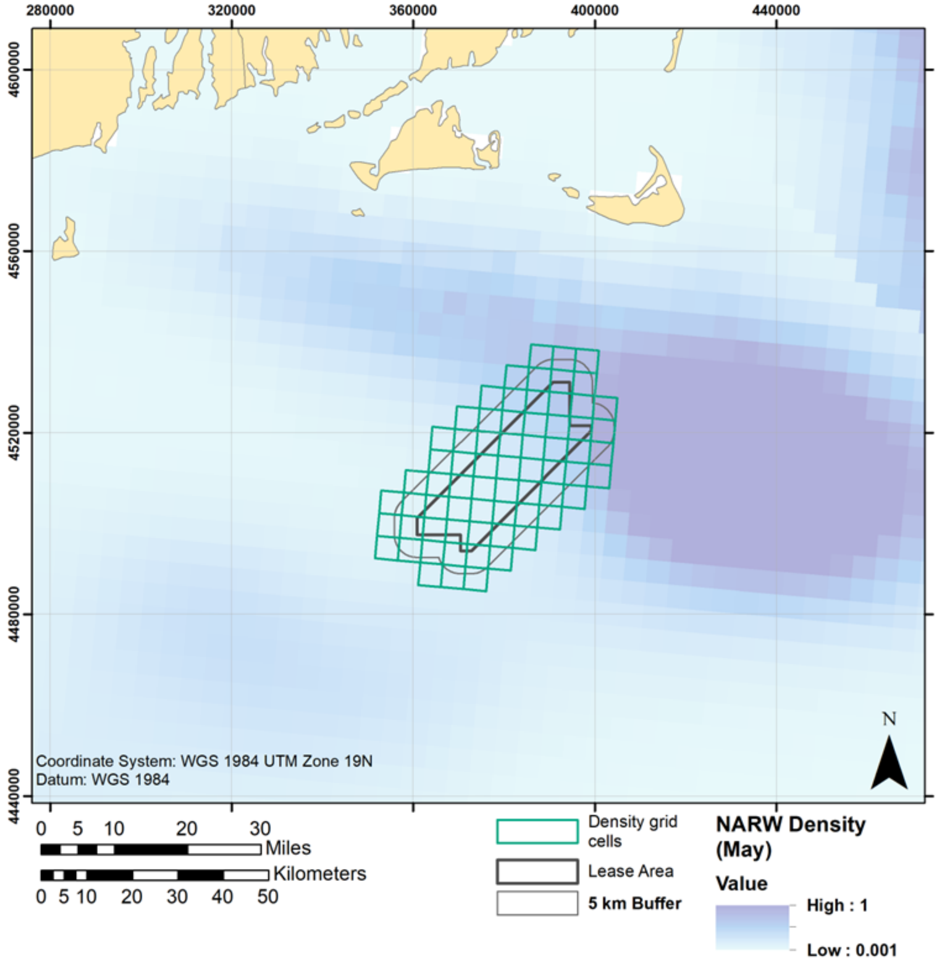

Figure 10. North Atlantic right whale density map showing highlighted grid cells from Roberts et al. (2016; 2023) used to calculate mean monthly species estimates (animals per 100 $km^2$) within a 5 km buffer (3.1 mi) around SouthCoast Wind Lease Area (Reproduced from Figure 11 in Appendix A).

Table 17. Average monthly marine mammal densities within 10 km (6.2 mi) of the Lease Area perimeter.

| | Monthly Average Densities (Individuals/1 km$^2$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| ***Mysticetes*** | | | | | | | | | | | | |
| Blue Whale* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Fin Whale* | 0.0022 | 0.0018 | 0.0015 | 0.0015 | 0.0030 | 0.0029 | 0.0047 | 0.0036 | 0.0027 | 0.0009 | 0.0005 | 0.0014 |
| Humpback Whale | 0.0003 | 0.0003 | 0.0005 | 0.0018 | 0.0031 | 0.0035 | 0.0021 | 0.0012 | 0.0017 | 0.0025 | 0.0020 | 0.0003 |
| Minke Whale | 0.0011 | 0.0013 | 0.0014 | 0.0075 | 0.0151 | 0.0175 | 0.0080 | 0.0048 | 0.0054 | 0.0050 | 0.0005 | 0.0007 |
| North Atlantic Right Whale* | 0.0054 | 0.0060 | 0.0054 | 0.0050 | 0.0037 | 0.0008 | 0.0004 | 0.0003 | 0.0004 | 0.0006 | 0.0011 | 0.0033 |
| Sei Whale* | 0.0004 | 0.0003 | 0.0005 | 0.0012 | 0.0019 | 0.0007 | 0.0002 | 0.0001 | 0.0002 | 0.0004 | 0.0009 | 0.0007 |
| ***Odontocetes*** | | | | | | | | | | | | |
| Atlantic Spotted Dolphin | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0004 | 0.0006 | 0.0005 | 0.0008 | 0.0043 | 0.0068 | 0.0017 | 0.0002 |
| Atlantic White-Sided Dolphin | 0.0263 | 0.0158 | 0.0111 | 0.0169 | 0.0369 | 0.0380 | 0.0204 | 0.0087 | 0.0193 | 0.0298 | 0.0225 | 0.0321 |
| Bottlenose Dolphin | 0.0051 | 0.0012 | 0.0008 | 0.0022 | 0.0097 | 0.0163 | 0.0177 | 0.0200 | 0.0198 | 0.0181 | 0.0160 | 0.0129 |
| Common Dolphin | 0.0933 | 0.0362 | 0.0320 | 0.0474 | 0.0799 | 0.1721 | 0.1549 | 0.2008 | 0.3334 | 0.3331 | 0.1732 | 0.1467 |
| Harbor Porpoise | 0.1050 | 0.1135 | 0.1081 | 0.0936 | 0.0720 | 0.0174 | 0.0174 | 0.0156 | 0.0165 | 0.0203 | 0.0219 | 0.0675 |
| Pilot Whales | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 |
| Risso’s Dolphin | 0.0005 | 0.0001 | 0.0000 | 0.0003 | 0.0014 | 0.0010 | 0.0013 | 0.0028 | 0.0035 | 0.0017 | 0.0015 | 0.0020 |
| Sperm Whale* | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0002 | 0.0003 | 0.0005 | 0.0017 | 0.0009 | 0.0006 | 0.0004 | 0.0003 |
| ***Pinnipeds*** | | | | | | | | | | | | |
| Gray Seal | 0.1812 | 0.1783 | 0.1277 | 0.1154 | 0.1520 | 0.0227 | 0.0059 | 0.0050 | 0.0085 | 0.0196 | 0.0750 | 0.1520 |
| Harbor Seal | 0.0118 | 0.0116 | 0.0083 | 0.0075 | 0.0099 | 0.0015 | 0.0004 | 0.0003 | 0.0006 | 0.0013 | 0.0049 | 0.0099 |

* Denotes species listed under the Endangered Species Act

### 6.3.2 Area Potentially Exposed to Sounds Above Threshold Levels from WTG and OSP Foundation Installation

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 (such as marine mammals, sea turtles, and fish) 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, sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness), and the make and energy of the hammer.

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. 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 taper, material, size, and length), the pile driving equipment, number of hammer strikes to install the pile, and approximate pile penetration depth. See Appendix A for a more detailed description of source modeling.

Forcing functions were computed for monopile and jacket foundations 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) used to estimate an equivalent acoustic source represented by a linear array of monopiles evenly distributed along the pile and detailed in Appendix A. Sound propagation of the impact pile driving impulsive sound signature as well as the non-impulsive vibratory piling sound signature was performed using FWRAM and modeling details are described in Appendix A. Decidecade spectral source levels for each pile diameter, hammer energy and modeled location are provided in Appendix A. A 2 dB increase in received levels for post-pile jacket foundation installation (expected installation method for the OSP foundations) was included in the propagation calculations based on a recommendation from Bellman et al. (2020).

During the summer months (June-August), the average temperature of the upper 10 to 15 m (32.8 to 49.2 ft) of the water column is higher, resulting in an increased surface layer sound speed. This creates a downward refracting 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 in the fall and winter months (September-February) results in a sound speed profile that is more uniform with depth. The shoulder months between summer and winter vary between the two. Modeling conducted for Scenarios 1 and 2 used separate sound speed profiles for "summer" months (April – November) and "winter" months (December – March).

Noise abatement systems (NAS) are often used to decrease the sound levels in the water near a source by inserting a local impedance change that acts as a barrier to sound transmission. Attenuation by impedance change can be achieved through a variety of technologies, including bubble curtains, evacuated sleeve systems (e.g., IHC-Noise Mitigation System (NMS)), encapsulated bubble systems (e.g., HydroSound Dampers (HSD)), or Helmholtz resonators (AdBm NMS). The effectiveness of each system is frequency dependent and may be influenced by local environmental conditions such as current and depth. For example, the size of the bubbles determines the effective frequency band of an air bubble curtain, with larger bubbles needed for lower frequencies.

The acoustic modeling included assumptions about the potential effectiveness of one or more NAS in reducing sounds propagated into the surrounding marine environment. Several recent studies summarizing the effectiveness of NAS have shown that broadband sound levels are likely to be reduced by anywhere from 7 to 17 dB, depending on the environment, pile size, and the size, configuration and number of systems used (Buehler et al. 2015; Bellmann et al. 2020). The single bubble curtain applied in shallow water environments regularly achieves 7-8 dB broadband attenuation (Lucke et al. 2011; Rustemeier et al. 2012; Bellmann 2014; Bellman 2019). More recent in situ measurements during installation of large monopiles (~8 m) for WTGs in comparable water depths and conditions indicate that attenuation levels of 10 dB are readily achieved for a single bubble curtain (Bellman 2019; Bellmann et al. 2020). Large bubble curtains tend to perform better and more reliably, particularly when deployed with two rings (Koschinski and Ludemann 2013; Bellmann 2014; Nehls et al. 2016). A California Department of Transportation study tested several small, single, bubble curtain systems and found that the best attenuation systems resulted in 10-15 dB of attenuation (Buehler et al. 2015). Buehler et al. (2015) concluded that attenuation greater than 10 dB could not be reliably predicted from small, single, bubble curtains because sound transmitted through the seabed and re-radiated into the water column is the dominant sound in the water for bubble curtains deployed immediately around the pile. Combinations of systems (e.g., double big bubble curtain, hydrodsound damper plus single big bubble curtain) potentially achieve much higher attenuation.

The type and number 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. A 10 dB decrease means the sound energy level is reduced by 90 percent. For comparison, exposure-based radial distance estimates assuming no attenuation, 6 dB attenuation, and 15 dB attenuation were also calculated.

Sounds produced by installation of the WTG and OSP foundations were modeled at two locations in the Lease Area. The locations were selected to represent the acoustic propagation environment within the Lease Area and may not be actual foundation locations. Water depths within the Lease Area range from 37 m to 64 m (121 ft to 210 ft). At modeling site L01 (Figure 11) the water depth is approximately 53 m (174 ft) while at site L02 the water depth is approximately 38 m (125 ft). The distribution of animal movement and exposure modeling locations was designed to provide representative spatial coverage within the Lease Area.

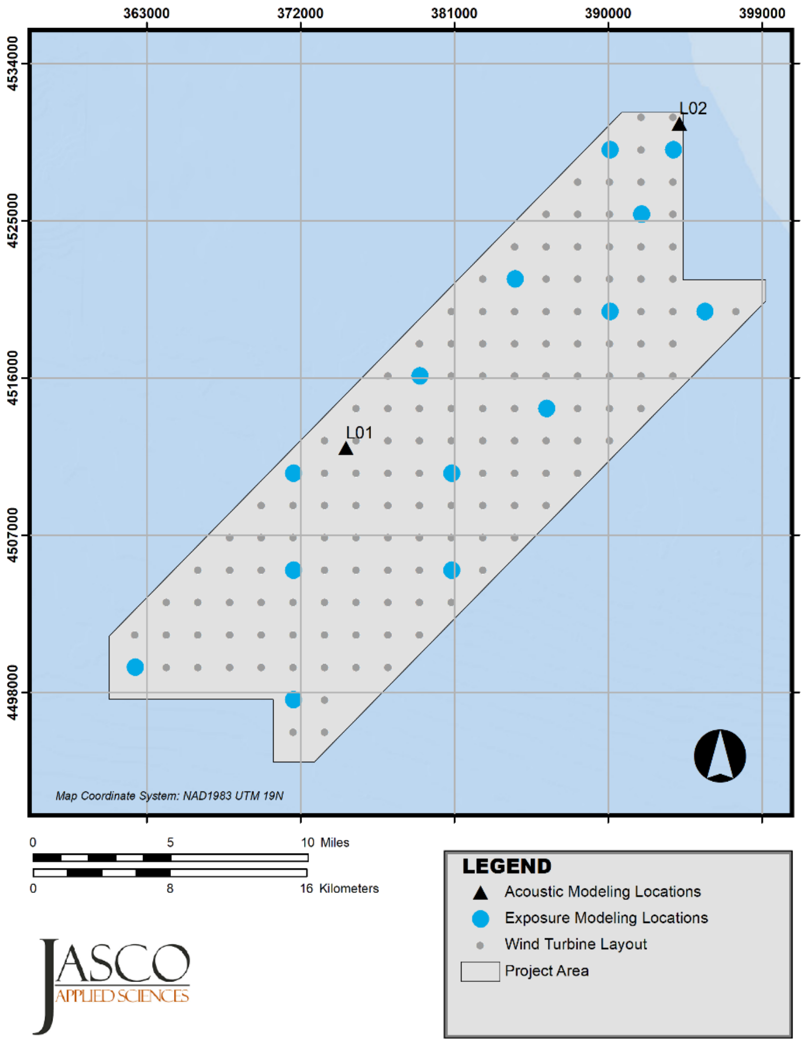

Figure 11. Location of acoustic propagation and animal exposure modeling for WTG and OSP foundation installation (reproduced from Figure 2 in Appendix A).

The ranges to threshold levels resulting from the acoustic modeling are reported using two different terminologies to reflect the underlying assumptions of the modeling. The term “acoustic range” is used to refer to acoustic modeling results that are based only on sound propagation modeling and not animal movement modeling. Acoustic ranges assume receivers of the sound energy (marine mammals) are stationary throughout the duration of the exposure. These are most applicable to thresholds where any single instantaneous exposure above the threshold is considered to cause a take, such as the Level A $\text{SPL}_{\text{pk}}$ thresholds and the Level B $\text{SPL}_{\text{rms}}$ threshold. For $\text{SEL}_{\text{cum}}$ based thresholds, acoustic ranges represent the maximum distance at which a receiver would be exposed above the threshold level if it remained present during the entire sound producing event or 24 hours, whichever is less. Since receivers are likely to move in and out of the threshold distance over the course of an exposure, these distances are more difficult to interpret. To address this, results from animal movement modeling are used to estimate an “exposure range”. This involves analyzing the movements and resulting accumulated sound energy during the exposure modeling and identifying the ranges within which most animals (95%) were exposed above the threshold level if they occurred within that range at any point in time. Therefore, the exposure ranges provide a more realistic assessment of the distances within which animals would need to occur in order to accumulate enough sound energy to cross the applicable $\mathrm{SEL_{cum}}$ threshold.

The Level A $\mathrm{SPL_{pk}}$ acoustic ranges from impact pile driving modeled in years 1 and 2 assuming 10 dB of attenuation in the summer and winter are shown in Table 18. Vibratory pile driving of 9/16 m WTG monopile foundations modeled as part of year 2 did not produce sounds above the $\mathrm{SPL_{pk}}$ thresholds. The $\mathrm{SPL_{pk}}$ ranges shown in the tables are the largest from among two modeling sites (Figure 11), hammer energies, and pile penetration depths. The acoustic ranges to the $R_{95\%}$ $\mathrm{SEL_{cum}}$ thresholds for WTG monopile and WTG jacket pin pile and for OSP jacket pin pile installations in summer and winter assuming various reductions in sound levels through use of a NAS are shown in Table 19 through Table 22. Table 19 and Table 20 compare the summer and winter acoustic ranges to the $\mathrm{SEL_{cum}}$ thresholds for installation of one WTG monopile, one WTG jacket foundation (with four 4.5 m pin piles), and one OSP jacket foundation (with four 4.5 pin piles) using impact pile driving only. Table 21 and Table 22 compare the summer and winter acoustic ranges to the $\mathrm{SEL_{cum}}$ thresholds for installation of one monopile and one jacket pin pile using vibratory hammering followed by impact piling. Level A acoustic ranges are very short for high-frequency cetaceans and phocid pinnipeds and therefore differences between the summer and winter sound speed profiles are not as pronounced for these ranges as they are for the longer low-frequency cetacean ranges (compare Table 19 with Table 20 and compare Table 21 with Table 22).

The distances to the unweighted 160 dB $\mathrm{SPL_{rms}}$ Level B harassment thresholds for years 1 and 2 assuming 10 dB of noise attenuation are provided in Table 23. The largest distances from the two modeling sites, hammer energy, and pile penetration depths are shown. Additional results specific to each site, hammer energy, and pile penetration depth are available in Appendix A. As described in Section 6.2, NMFS currently uses the unweighted threshold for assessing potential Level B harassment of marine mammals, while the frequency-weighted thresholds take into account the hearing abilities of marine mammals relative to the sounds produced by the activity. Thus, the frequency-weighted ranges provide a more realistic indication of the distances at which sounds perceived by marine mammals within each hearing group might reach the established threshold.

Table 18. Acoustic ranges ($R_{95\%}$) in km to Level A peak sound pressure level ($\mathrm{SPL_{pk}}$) thresholds for marine mammals from impact pile driving assumed in years 1 and 2 for a 9/16 m WTG monopile, 4.5 m WTG jacket pin-pile, and 4.5 m OSP jacket pin pile assuming 10 dB of broadband noise attenuation.

| | | Range (m) | | | | | |
|---|---|---|---|---|---|---|---|
| | $\mathrm{SPL_{pk}}$ Threshold | 16 m WTG Monopile | | 4.5 m WTG Jacket Pin Pile | | 4.5 m OSP Jacket Pin Pile | |
| **Hearing Group** | **(dB re 1 µPa)** | **Summer** | **Winter** | **Summer** | **Winter** | **Summer** | **Winter** |
| Low-frequency | 219 | - | - | - | - | - | - |
| Mid-frequency | 230 | - | - | - | - | - | - |
| High-frequency | 202 | 0.27 | 0.26 | 0.12 | 0.13 | 0.14 | 0.13 |
| Phocid pinniped | 218 | - | - | - | - | - | - |

Table 19. Acoustic ranges ($R_{95\%}$) to Level A cumulative sound exposure level ($\text{SEL}_{\text{cum}}$) thresholds for marine mammals from impact only pile driving assumptions in years 1 and 2 for installation of a 9/16 m WTG monopile, four 4.5 m WTG jacket pin piles, and four 4.5 m OSP jacket pin piles in summer assuming various levels of broadband noise attenuation.

| Hearing Group | $\text{SEL}_{\text{cum}}$ Threshold (dB re 1 $\mu Pa^2$) | Range (km) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 16 m WTG Monopile | | | | 4.5 m WTG Jacket Pin Piles | | | | 4.5 m OSP Jacket Pin Piles | | | |
| | | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 |
| Low-frequency | 183 | 11.67 | 7.92 | 6.09 | 4.24 | 10.73 | 6.78 | 4.94 | 3 | 12.45 | 7.95 | 5.83 | 3.78 |
| Mid-frequency | 185 | - | - | - | - | - | - | - | - | - | - | - | - |
| High-frequency | 155 | 1.15 | 0.52 | 0.26 | 0.14 | 0.48 | 0.19 | 0.09 | 0.04 | 0.64 | 0.26 | 0.11 | 0.06 |
| Phocid pinniped | 185 | 2.71 | 1.41 | 0.79 | 0.35 | 1.95 | 0.9 | 0.48 | 0.22 | 2.53 | 1.21 | 0.68 | 0.32 |

Table 20. Acoustic ranges ($R_{95\%}$) to Level A cumulative sound exposure level ($\text{SEL}_{\text{cum}}$) thresholds for marine mammals from impact only pile driving assumptions in years 1 and 2 for installation of a 9/16 m WTG monopile, four 4.5 m WTG jacket pin piles, and four 4.5 m OSP jacket pin piles in winter assuming various levels of broadband noise attenuation.

| Hearing Group | $\text{SEL}_{\text{cum}}$ Threshold (dB re 1 $\mu Pa^2$) | Range (km) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 16 m WTG Monopile | | | | 4.5 m WTG Jacket Pin Piles | | | | 4.5 m OSP Jacket Pin Piles | | | |
| | | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 |
| Low-frequency | 183 | 14.42 | 9.05 | 6.68 | 4.53 | 13.45 | 7.47 | 5.16 | 3.07 | 16.43 | 8.99 | 6.21 | 3.86 |
| Mid-frequency | 185 | - | - | - | - | - | - | - | - | - | - | - | - |
| High-frequency | 155 | 1.1 | 0.49 | 0.3 | 0.13 | 0.48 | 0.17 | 0.09 | 0.04 | 0.64 | 0.25 | 0.12 | 0.06 |
| Phocid pinniped | 185 | 2.84 | 1.46 | 0.79 | 0.34 | 1.99 | 0.93 | 0.49 | 0.22 | 2.54 | 1.23 | 0.71 | 0.34 |

Table 21. Acoustic ranges ($R_{95\%}$) to Level A cumulative sound exposure level ($\text{SEL}_{\text{cum}}$) thresholds for marine mammals from vibratory and impact pile driving assumptions in year 2 for installation of a 9/16 m WTG monopile and a 4.5 m WTG jacket pin pile in summer assuming various levels of broadband noise attenuation.

| Hearing Group | $\text{SEL}_{\text{cum}}$ Threshold (dB re 1 $\mu Pa^2$) | Range (km) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 16 m WTG Monopile | | | | 4.5 m WTG Jacket Pin Pile | | | |
| | | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 |
| Low-frequency | 183 | 11.88 | 8.05 | 6.19 | 4.35 | 6.13 | 3.45 | 2.11 | 1.14 |
| Mid-frequency | 185 | - | - | - | - | - | - | - | - |
| High-frequency | 155 | 0.96 | 0.3 | 0.2 | 0.12 | 0.11 | 0.05 | 0.02 | - |
| Phocid pinniped | 185 | 2.74 | 1.44 | 0.81 | 0.36 | 0.65 | 0.23 | 0.11 | 0.06 |

Table 22. Acoustic ranges (R$_{95\%}$) to Level A cumulative sound exposure level (SEL$_{cum}$) thresholds for marine mammals from vibratory and impact pile driving assumptions in year 2 for installation of a 9/16 m WTG monopile and a 4.5 m WTG jacket pin pile in winter assuming various levels of broadband noise attenuation.

| Hearing Group | SEL$_{cum}$ Threshold (dB re 1 µPa$^2$) | Range (km) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 16 m WTG Monopile | | | | 4.5 m WTG Jacket Pin Pile | | | |
| | | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 |
| Low-frequency | 183 | 14.63 | 9.22 | 6.8 | 4.62 | 6.55 | 3.46 | 2.15 | 1.15 |
| Mid-frequency | 185 | - | - | - | - | - | - | - | - |
| High-frequency | 155 | 0.89 | 0.35 | 0.2 | 0.13 | 0.11 | 0.05 | 0.02 | - |
| Phocid pinniped | 185 | 2.87 | 1.48 | 0.85 | 0.39 | 0.6 | 0.22 | 0.11 | 0.06 |

Table 23. Acoustic ranges (R$_{95\%}$) to the Level B, 160 dB re 1 µPa sound pressure level (SPL$_{rms}$) threshold from impact pile driving and Level B, 120 dB re 1 µPa SPL$_{rms}$ from vibratory pile driving assumptions in year 2 for a 9/16 m WTG monopile, 4.5 m WTG jacket pin pile, and 4.5 m OSP jacket pin piles assuming 10 dB of broadband noise attenuation in summer and winter.

| Range (km) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Impact Pile Driving (160 dB SPL$_{rms}$) | | | | | | Vibratory Pile Driving (120 dB SPL$_{rms}$) | | | |
| 16 m WTG Monopile | | 4.5 m WTG Jacket Pin Pile | | 4.5 m OSP Jacket Pin Pile | | 16 m WTG Monopile | | 4.5 m WTG Jacket Pin Pile | |
| Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| 7.44 | 8.63 | 4.18 | 4.41 | 4.88 | 5.24 | 42.02 | 84.63 | 15.83 | 21.92 |

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 movement patterns for each species. Substantial differences (greater than 500 m [1,640 ft]) between species within the same hearing group occurred for low frequency-cetaceans, so exposure ranges are shown separately for those species. For mid-frequency cetaceans and pinnipeds, the largest value from any single species was selected.

Years 1 and 2 include various combinations of sequential WTG foundation installations that use impact pile driving only, both vibratory and impact pile driving, and concurrent WTG and OSP installations using only impact pile driving, each of which generates different ER$_{95\%}$ distances. The ER$_{95\%}$ distances for sequential installation of WTG foundations using only impact pile driving are shown in Table 24 for summer and Table 25 for winter. The ER$_{95\%}$ distances for sequential installation of WTG foundations using both vibratory and impact pile driving in summer are shown in Table 26. Lastly, potential concurrent installation of WTG and OSP foundations would only occur in the summer months and those ER$_{95\%}$ distances are shown in Table 27.

The ER$_{95\%}$ distances for sequential installation of 1 or 2 WTG monopiles (Table 24 and Table 25) are quite similar to those for when one WTG monopile is installed simultaneously with 4 OSP jacket pin piles (Table 27). The greater amount of pile driving occurring on a single day seems like it should cause ER$_{95\%}$ distances to be greater on days with simultaneous pile driving at two locations. However, for that to happen, the animal movement modeling would have to show that animals would routinely occur close enough to one pile driving location (e.g. WTG monopile) to accumulate enough sound energy without going over the $\text{SEL}_{\text{cum}}$ threshold and then also occur at the second pile driving location (e.g. OSP jacket) at a distance close enough to accumulate the remaining sound energy needed to cross the $\text{SEL}_{\text{cum}}$ threshold. The animal movement modeling showed this sequence of events did not happen often enough when WTG monopiles were being installed to cause a consistent increase in the $\text{ER}_{95\%}$ distances across all species. In the case of WTG jacket foundation installations occurring simultaneously with OSP jacket foundation installations (Table 24) this sequence of events did happen more often, so the $\text{ER}_{95\%}$ distances were consistently larger than for installation of a single WTG jacket foundation on a given day. This was likely a result of the overall longer duration of pile driving per day involved with installing the 4 pin piles for each jacket foundation.

Table 24. Exposure ranges[1] ($\text{ER}_{95\%}$) to Level A cumulative sound exposure level ($\text{SEL}_{\text{cum}}$) thresholds for marine mammals during sequential installation of one or two 9/16 m WTG monopiles, four 4.5 m WTG jacket pin piles and four 4.5 m OSP jacket pin piles using only impact pile driving in summer assuming 10 dB of broadband noise attenuation.

| | | Range (km) | | | |
|---|---|---|---|---|---|
| **Hearing Group** | **$\text{SEL}_{\text{cum}}$ Threshold (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)** | **16 m WTG Monopile 1 Pile/Day** | **16 m WTG Monopile 2 Piles/Day** | **4.5 m WTG Jacket Pin Piles 4 Piles/Day** | **4.5 m OSP Jacket Pin Piles 4 Piles/Day** |
| Low-frequency | 183 | | | | |
| Fin Whale* | | 3.99 | 4.15 | 2.37 | 3.18 |
| Humpback Whale | | 3.13 | 3.46 | 1.88 | 2.36 |
| Minke Whale (migrating) | | 2.41 | 2.42 | 1.24 | 1.58 |
| NA Right Whale* | | 2.82 | 2.95 | 1.73 | 2.01 |
| Sei Whale* (migrating) | | 3.06 | 3.19 | 1.96 | 2.59 |
| Mid-frequency | 185 | 0 | 0 | 0 | 0 |
| High-frequency | 155 | 0 | 0 | 0 | 0 |
| Phocid pinnipeds | 185 | 0.04 | 0.12 | 0 | 0.41 |

* Denotes species listed under the Endangered Species Act

[1] Exposure ranges are a result of animal movement modelling.

Table 25. Exposure ranges[1] (ER$_{95\%}$) to Level A cumulative sound exposure level (SEL$_{cum}$) thresholds for marine mammals during sequential installation of one 9/16 m WTG monopile and four 4.5 m WTG jacket pin piles using only impact pile driving in winter assuming 10 dB of broadband noise attenuation.

| | | Range (km) | |
|---|---|---|---|
| **Hearing Group** | **SEL$_{cum}$ Threshold (dB re 1 $\mu$Pa$^2$·s)** | **16 m WTG Monopile 1 Pile/Day** | **4.5 m WTG Jacket Pin Piles 4 Piles/Day** |
| Low-frequency | 183 | | |
| Fin Whale* | | 4.49 | 2.55 |
| Humpback Whale | | 3.66 | 1.96 |
| Minke Whale (migrating) | | 3 | 1.28 |
| NA Right Whale* | | 3.23 | 1.85 |
| Sei Whale* (migrating) | | 3.38 | 2.22 |
| Mid-frequency | 185 | 0 | 0 |
| High-frequency | 155 | 0 | 0 |
| Phocid pinnipeds | 185 | 0.34 | 0.32 |

* Denotes species listed under the Endangered Species Act

[1] Exposure ranges are a result of animal movement modelling.

Table 26. Exposure ranges[1] (ER$_{95\%}$) to Level A cumulative sound exposure level (SEL$_{cum}$) thresholds for marine mammals during sequential installation of two 9/16 m WTG monopiles or four 4.5 m WTG jacket pin piles in year 2 assuming 10 dB of broadband noise attenuation in summer using combined vibratory and impact pile driving.

| | | Range (km) | | | |
|---|---|---|---|---|---|
| | | **16 m WTG Monopile 2 pile(s)/Day** | | **4.5 m WTG Jacket Pin Piles 4 Piles/Day** | |
| **Hearing Group** | **SEL$_{cum}$ Threshold (dB re 1 $\mu$Pa$^2$·s)** | **Impact** | **Vibratory** | **Impact** | **Vibratory** |
| Low-frequency | 183 | | | | |
| Fin Whale* | | 4.11 | 0.08 | 2.25 | 0 |
| Humpback Whale | | 3.49 | 0.18 | 1.84 | 0 |
| Minke Whale (migrating) | | 2.37 | 0 | 1.13 | 0 |
| NA Right Whale* | | 3.07 | 0.13 | 1.57 | 0 |
| Sei Whale* (migrating) | | 3.13 | 0 | 1.84 | 0 |
| Mid-frequency | 185 | 0 | 0 | 0 | 0 |
| High-frequency | 155 | 0 | 0 | 0 | 0 |
| Phocid pinnipeds | 185 | 0.11 | 0 | 0 | 0 |

* Denotes species listed under the Endangered Species Act

[1] Exposure ranges are a result of animal movement modelling.

Table 27. Exposure ranges[1] ($ER_{95\%}$) to Level A cumulative sound exposure level ($SEL_{cum}$) thresholds for marine mammals during concurrent installations of one 16 m WTG monopile and four 4.5 m OSP jacket pin piles or four 4.5 m WTG jacket pin piles and four 4.5 m OSP jacket pin piles in years 1 and 2 using only impact pile driving assuming 10 dB of broadband noise attenuation in summer.

| Hearing Group | $SEL_{cum}$ Threshold (dB re 1 $\mu Pa^2 \cdot s$) | Range (km) | |
|---|---|---|---|
| | | 16 m WTG Monopile (1 Pile/Day) and; 4.5 m OSP Jacket Pin Piles (4 Piles/Day) | 4.5 m WTG Jacket Pin Piles (4 Piles/Day) and; 4.5 m OSP Jacket Pin Piles (4 Piles/Day) |
| Low-frequency | 183 | | |
| Fin Whale* | | 4.25 | 3.58 |
| Humpback Whale | | 3.47 | 2.57 |
| Minke Whale (migrating) | | 2.06 | 1.56 |
| NA Right Whale* | | 2.85 | 1.92 |
| Sei Whale* (migrating) | | 3.06 | 2.41 |
| Mid-frequency | 185 | 0 | 0 |
| High-frequency | 155 | 0 | 0 |
| Phocid pinnipeds | 185 | 0.31 | 0.17 |

* Denotes species listed under the Endangered Species Act

[1] Exposure ranges are a result of animal movement modelling.

### 6.3.3 Exposure and Take Estimates from WTG and OSP Foundation Installation

Exposure modeling for years 1 and 2 of WTG and OSP foundation installation was conducted at the sites shown in Figure 11, using the Project 1 and Project 2 proposed construction scenarios described above and the results from the location that produced the highest exposure estimates in each year were selected. Exposure estimates for Year 1 are shown in Table 28 and Table 29 (scenarios 1 & 2) and Year 2 exposure estimates are shown in Table 30 – Table 32 (scenarios 1 – 3). The Level B exposure estimates shown from sound exposure modeling are based on the unweighted 160 dB $SPL_{rms}$ criterion for impact pile driving and the unweighted 120 dB $SPL_{rms}$ criterion for vibratory pile driving. The PSO data-based estimates shown in these tables were calculated as described in Section 6.1.2 using the total number of days of installation for each scenario shown in Table 12 – Table 16 and the daily sighting rate for each species shown in Table 7. The largest of these Level B estimates, or the mean group size value in cases where the group size is larger than any of these estimates, is rounded up to an integer to arrive at a final take estimate (shown in the Total Estimated Take for Scenario column).

The Level A estimates shown in Table 28 – Table 32 are from the exposure modeling and are only from the $SEL_{cum}$ threshold as the short distances to the $SPL_{pk}$ thresholds resulted in no meaningful likelihood of take from exposure to those sound levels. These values are rounded up to an integer to arrive at a Level A take estimate (shown in the Total Estimated Take for Scenario column). In Year 2, for cases when impact pile driving is preceded by vibratory piling, the sound energy accumulated during the vibratory and impact piling phases is summed to obtain the $SEL_{cum}$ for the entire pile installation. It is also important to note that the Level A take estimates are calculated in the absence of the planned monitoring and mitigation measures, other than sound attenuation, which are designed to prevent most Level A takes. Request for Level A takes associated with all activities is included in Section 6.7.

Table 28. Level A and Level B exposure and take estimates for Year 1 – Scenario 1 (impact only pile driving) installation of 71 WTG monopile foundations and 1 OSP foundation (12 jacket pin piles) assuming 10 dB of noise attenuation. Level A exposure/take estimates assume no implementation of monitoring and mitigation measures other than 10 dB of noise attenuation. Level B modeled exposure and take estimates are based on distances to the unweighted 160 dB threshold.

| | WTG Monopile and OSP Jacket Modeled Exposure Estimates[1] Year 1 - Scenario 1 | | | | Total Estimated Take for Scenario Year 1 - Scenario 1 | |
|---|---|---|---|---|---|---|
| **Species** | **Level A ($SEL_{cum}$)** | **Level B ($SPL_{rms}$)** | **PSO Data Based Estimate** | **Mean Group Size** | **Level A Take[2]** | **Level B Take[3]** |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | N/A | N/A | - | 1.0 | 0 | 1 |
| Fin Whale* | 13.2 | 38.8 | 3.4 | 1.8 | 14 | 39 |
| Humpback Whale | 9.3 | 28.4 | 32.4 | 2.0 | 10 | 33 |
| Minke Whale | 45.7 | 168.6 | 6.4 | 1.4 | 46 | 169 |
| North Atlantic Right Whale* | 2.1 | 8.8 | - | 2.4 | 3 | 9 |
| Sei Whale* | 1.3 | 4.7 | 0.9 | 1.6 | 2 | 5 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | 0.0 | 22.71 | - | 29.0 | 0 | 29 |
| Atlantic White-Sided Dolphin | 0.0 | 520.8 | - | 27.9 | 0 | 521 |
| Bottlenose Dolphin | 0.0 | 267.4 | 84.2 | 12.3 | 0 | 268 |
| Common Dolphin | 0.0 | 6,975.3 | 735.6 | 34.9 | 0 | 6,976 |
| Harbor Porpoise | 0.0 | 312.2 | 0.1 | 2.7 | 0 | 313 |
| Pilot Whales | 0.0 | 60.7 | 3.7 | 10.3 | 0 | 61 |
| Risso's Dolphin | 0.0 | 36.5 | - | 5.4 | 0 | 37 |
| Sperm Whale* | 0.0 | 12.4 | 0.3 | 2.0 | 0 | 13 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | 0.1 | 209.6 | 2.0 | 1.4 | 1 | 210 |
| Harbor Seal | 0.0 | 15.1 | 30.5 | 1.4 | 1 | 31 |

* Denotes species listed under the Endangered Species Act.

[1] Modeled exposure estimates in Appendix A are provided to two decimal places. For readability, they are presented here with a single decimal place. Due to rounding, take estimates may be greater than exposure estimates.

[2] Total estimated Level A take shown here is based on the exposure modeling. For some species, however, like the North Atlantic right whale, no Level A take is requested because it is presumed that mitigation and monitoring will prevent Level A take (see Section 6.7).

[3] Total estimated Level B take is the maximum of the modeled exposure estimate, PSO data sighting rate, and mean group size rounded up to an integer.

Table 29. Level A and Level B exposure and take estimates for Year 1 – Scenario 2 (impact only pile driving) installation of 85 WTG jacket foundations and 1 OSP foundation (16 jacket pin piles) assuming 10 dB of noise attenuation. Level A exposure/take estimates assume no implementation of monitoring and mitigation measures other than 10 dB of noise attenuation. Level B modeled exposure and take estimates are based on distances to the unweighted 160 dB. threshold.

| | WTG Jacket and OSP Jacket Modeled Exposure Estimates[1] | | | | Total Estimated Take for Scenario | |
|---|---|---|---|---|---|---|
| | Year 1 - Scenario 2 | | | | Year 1 - Scenario 2 | |
| Species | Level A ($SEL_{cum}$) | Level B ($SPL_{rms}$) | PSO Data Based Estimate | Mean Group Size | Level A Take[2] | Level B Take[3] |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | N/A | N/A | - | 1.0 | 0 | 1 |
| Fin Whale* | 10.3 | 22.4 | 3.8 | 1.8 | 11 | 23 |
| Humpback Whale | 11.7 | 28.4 | 37.0 | 2.0 | 12 | 37 |
| Minke Whale | 45.6 | 196.1 | 7.3 | 1.4 | 46 | 197 |
| North Atlantic Right Whale* | 3.9 | 12.0 | - | 2.4 | 4 | 12 |
| Sei Whale* | 2.3 | 6.1 | 1.0 | 1.6 | 3 | 7 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | 0.0 | 24.4 | - | 29.0 | 0 | 29 |
| Atlantic White-Sided Dolphin | 0.0 | 727.1 | - | 27.9 | 0 | 728 |
| Bottlenose Dolphin | 0.0 | 303.5 | 96.0 | 12.3 | 0 | 304 |
| Common Dolphin | 0.0 | 8,552.1 | 839.2 | 34.9 | 0 | 8,553 |
| Harbor Porpoise | 0.0 | 377.3 | 0.2 | 2.7 | 0 | 378 |
| Pilot Whales | 0.0 | 39.8 | 4.2 | 10.3 | 0 | 40 |
| Risso's Dolphin | 0.0 | 29.1 | - | 5.4 | 0 | 30 |
| Sperm Whale* | 0.0 | 10.0 | 0.3 | 2.0 | 0 | 10 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | 0.2 | 224.9 | 2.3 | 1.4 | 1 | 225 |
| Harbor Seal | 0.0 | 25.8 | 34.8 | 1.4 | 0 | 35 |

* Denotes species listed under the Endangered Species Act.

[1] Modeled exposure estimates in Appendix A are provided to two decimal places. For readability, they are presented here with a single decimal place. Due to rounding, take estimates may be greater than exposure estimates.

[2] Total estimated Level A take shown here is based on the exposure modeling. For some species, however, like the North Atlantic right whale, no Level A take is requested because it is presumed that mitigation and monitoring will prevent Level A take (see Section 6.7).

[3] Total estimated Level B take is the maximum of the modeled exposure estimate, PSO data sighting rate, and mean group size rounded up to an integer.

Table 30. Level A and Level B exposure and take estimates for Year 2 – Scenario 1 (impact only pile driving) for installation of 68 WTG monopile foundations and 1 OSP foundation (12 jacket pin piles) assuming 10 dB of noise attenuation. Level A exposure/take estimates assume no implementation of monitoring and mitigation measures other than 10 dB of noise attenuation. Level B modeled exposure and take estimates are based on distances to the unweighted 160 dB. threshold.

| | WTG Monopile and OSP Jacket Modeled Exposure Estimates[1] | | | | Total Estimated Take for Scenario | |
|---|---|---|---|---|---|---|
| | Year 2 - Scenario 1 | | | | Year 2 - Scenario 1 | |
| Species | Level A ($SEL_{cum}$) | Level B ($SPL_{rms}$) | PSO Data based Estimate | Mean Group Size | Level A Take[2] | Level B Take[3] |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | N/A | N/A | - | 1.0 | 0 | 1 |
| Fin Whale* | 11.0 | 31.9 | 3.2 | 1.8 | 11 | 32 |
| Humpback Whale | 9.7 | 28.8 | 31.1 | 2.0 | 10 | 32 |
| Minke Whale | 45.0 | 163.9 | 6.2 | 1.4 | 46 | 164 |
| North Atlantic Right Whale* | 2.2 | 9.1 | - | 2.4 | 3 | 10 |
| Sei Whale* | 1.5 | 5.2 | 0.8 | 1.6 | 2 | 6 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | 0.0 | 26.05 | - | 29.0 | 0 | 29 |
| Atlantic White-Sided Dolphin | 0.0 | 550.1 | - | 27.9 | 0 | 551 |
| Bottlenose Dolphin | 0.0 | 249.7 | 80.6 | 12.3 | 0 | 250 |
| Common Dolphin | 0.0 | 6,912.3 | 704.5 | 34.9 | 0 | 6,913 |
| Harbor Porpoise | 0.0 | 304.3 | 0.1 | 2.7 | 0 | 305 |
| Pilot Whales | 0.0 | 57.5 | 3.5 | 10.3 | 0 | 58 |
| Risso's Dolphin | 0.0 | 31.9 | - | 5.4 | 0 | 32 |
| Sperm Whale* | 0.0 | 10.4 | 0.3 | 2.0 | 0 | 11 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | 0.1 | 234.1 | 1.9 | 1.4 | 1 | 235 |
| Harbor Seal | 0.0 | 16.9 | 29.2 | 1.4 | 1 | 30 |

* Denotes species listed under the Endangered Species Act.

[1] Modeled exposure estimates in Appendix A are provided to two decimal places. For readability, they are presented here with a single decimal place. Due to rounding, take estimates may be greater than exposure estimates. In this table, the Level A exposure estimate for minke whales is 45.01, which is rounded up to a take estimate of 46.

[2] Total estimated Level A take shown here is based on the exposure modeling. For some species, however, like the North Atlantic right whale, no Level A take is requested because it is presumed that mitigation and monitoring will prevent Level A take (see Section 6.7).

[3] Total estimated Level B take is the maximum of the modeled exposure estimate, PSO data sighting rate, and mean group size rounded up to an integer.

Table 31. Level A and Level B exposure and take estimates for Year 2 – Scenario 2 (impact and vibratory pile driving) installation of 73 WTG monopile foundations and 1 OSP foundation (12 jacket pin piles) assuming 10 dB of noise attenuation. Level A exposure/take estimates assume no implementation of monitoring and mitigation measures other than 10 dB of noise attenuation. Level B modeled exposure and take estimates are based on distances to the unweighted 160 dB.or 120 dB thresholds.

| | **Maximum WTG Monopile and OSP Jacket Modeled Exposure Estimates[1]** | | | | **Total Estimated Take for Scenario** | |
|---|---|---|---|---|---|---|
| | **Year 2 - Scenario 2** | | **PSO Data Based Estimate** | **Mean Group Size** | **Year 2 - Scenario 2** | |
| **Species** | **Level A ($SEL_{cum}$)** | **Level B ($SPL_{rms}$)** | | | **Level A Take[2]** | **Level B Take[3]** |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | N/A | N/A | - | 1.0 | 0 | 1 |
| Fin Whale* | 14.3 | 480.2 | 7.2 | 1.8 | 15 | 481 |
| Humpback Whale | 10.7 | 282.0 | 69.9 | 2.0 | 11 | 282 |
| Minke Whale | 49.6 | 868.2 | 13.9 | 1.4 | 50 | 869 |
| North Atlantic Right Whale* | 2.3 | 100.0 | - | 2.4 | 3 | 100 |
| Sei Whale* | 1.4 | 41.9 | 1.9 | 1.6 | 2 | 42 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | 0.0 | 319.59 | - | 29.0 | 0 | 320 |
| Atlantic White-Sided Dolphin | 0.0 | 3,045.0 | - | 27.9 | 0 | 3,045 |
| Bottlenose Dolphin | 0.0 | 2,341.1 | 181.4 | 12.3 | 0 | 2,342 |
| Common Dolphin | 0.0 | 41,092.2 | 1,585.1 | 34.9 | 0 | 41,093 |
| Harbor Porpoise | 0.0 | 2,381.3 | 0.3 | 2.7 | 0 | 2,382 |
| Pilot Whales | 0.0 | 634.0 | 8.0 | 10.3 | 0 | 635 |
| Risso's Dolphin | 0.0 | 1,759.8 | - | 5.4 | 0 | 1,760 |
| Sperm Whale* | 0.0 | 121.4 | 0.6 | 2.0 | 0 | 122 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | 0.2 | 8,330.8 | 4.3 | 1.4 | 1 | 8,331 |
| Harbor Seal | 0.0 | 432.0 | 65.8 | 1.4 | 1 | 432 |

* Denotes species listed under the Endangered Species Act.

[1] Modeled exposure estimates in Appendix A are provided to two decimal places. For readability, they are presented here with a single decimal place. Due to rounding, take estimates may be greater than exposure estimates. In this table, the Level B exposure estimate for pilot whales is 634.03, which is rounded up to a take estimate of 635.

[2] Total estimated Level A take shown here is based on the exposure modeling. For some species, however, like the North Atlantic right whale, no Level A take is requested because it is presumed that mitigation and monitoring will prevent Level A take (see Section 6.7).

[3] Total estimated Level B take is the maximum of the modeled exposure estimate, PSO data sighting rate, and mean group size rounded up to an integer.

Table 32. Level A and Level B exposure and take estimates for Year 2 – Scenario 3 (impact and vibratory pile driving) installation of 62 WTG jacket foundations and 1 OSP foundation (16 jacket pin piles) assuming 10 dB of noise attenuation. Level A exposure/take estimates assume no implementation of monitoring and mitigation measures other than 10 dB of noise attenuation. Level B modeled exposure and take estimates are based on distances to the unweighted 160 dB or 120 dB thresholds.

| | Maximum WTG Jacket and OSP Jacket Modeled Exposure Estimates[1] | | | | Total Estimated Take for Scenario | |
|---|---|---|---|---|---|---|
| | Year 2 - Scenario 3 | | | | Year 2 - Scenario 3 | |
| Species | Level A ($SEL_{cum}$) | Level B ($SPL_{rms}$) | PSO Data Based Estimate | Mean Group Size | Level A Take[2] | Level B Take[3] |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | N/A | N/A | - | 1.0 | 0 | 1 |
| Fin Whale* | 8.1 | 113.0 | 3.4 | 1.8 | 9 | 113 |
| Humpback Whale | 8.7 | 97.7 | 32.4 | 2.0 | 9 | 98 |
| Minke Whale | 34.9 | 491.1 | 6.4 | 1.4 | 35 | 492 |
| North Atlantic Right Whale* | 3.1 | 40.0 | - | 2.4 | 4 | 40 |
| Sei Whale* | 1.7 | 18.0 | 0.9 | 1.6 | 2 | 19 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | 0.0 | 74.62 | - | 29.0 | 0 | 75 |
| Atlantic White-Sided Dolphin | 0.0 | 1,647.5 | - | 27.9 | 0 | 1,648 |
| Bottlenose Dolphin | 0.0 | 829.5 | 84.2 | 12.3 | 0 | 830 |
| Common Dolphin | 0.0 | 20,176.9 | 735.6 | 34.9 | 0 | 20,177 |
| Harbor Porpoise | 0.0 | 1,001.1 | 0.1 | 2.7 | 0 | 1,002 |
| Pilot Whales | 0.0 | 195.0 | 3.7 | 10.3 | 0 | 195 |
| Risso's Dolphin | 0.0 | 135.7 | - | 5.4 | 0 | 136 |
| Sperm Whale* | 0.0 | 35.1 | 0.3 | 2.0 | 0 | 36 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | 0.3 | 992.8 | 2.0 | 1.4 | 1 | 993 |
| Harbor Seal | 0.0 | 70.2 | 30.5 | 1.4 | 0 | 71 |

* Denotes species listed under the Endangered Species Act.

[1] Modeled exposure estimates in Appendix A are provided to two decimal places. For readability, they are presented here with a single decimal place. Due to rounding, take estimates may be greater than exposure estimates. In this table, the Level B exposure estimate for sei whales is 18.01, which is rounded up to a take estimate of 19.

[2] Total estimated Level A take shown here is based on the exposure modeling. For some species, however, like the North Atlantic right whale, no Level A take is requested because it is presumed that mitigation and monitoring will prevent Level A take (see Section 6.7).

[3] Total estimated Level B take is the maximum of the modeled exposure estimate, PSO data sighting rate, and mean group size rounded up to an integer.

### *6.3.4 Requested Take from WTG and OSP Foundation Installation*

The model-based Level A exposure estimates are conservative in that they assume no mitigation measures other than 10 dB of sound attenuation. The additional mitigation measures described in Section 11, including soft-start and clearance/shutdown zones, when implemented in practice will reduce the already very low probability of Level A take. Additionally, the modeling does not include any aversive behavior by the animals, yet we know many marine mammals avoid areas of loud sounds. Thus, it is unlikely that an animal would remain within the Level A SEL$_{cum}$ zone long enough to incur PTS and potentially could avert away during the soft-start procedure. Therefore, SouthCoast Wind is not requesting Level A take incidental to foundation installation for most marine mammal species.

However, as a precautionary measure, because the WTG and OSP foundation installation exposure ranges for fin whales were in some cases substantially larger than for other mysticete whales, some Level A take is being requested for this species. The next largest exposure range distance to a mysticete whale was selected as the pre-start clearance/shutdown zone to avoid Level A take of other mysticete species and assumed that this along with the soft-start procedure and potential for animal aversion to loud sounds will avoid Level A take of other species. In most installation scenarios, 15-20% of the fin whale exposure range extends beyond the planned clearance/shutdown distance (exposure range for the second largest mysticete). Therefore, the requested Level A take for fin whales incidental to foundation installation is 20% of the fin whale Level A exposure estimates produced by the exposure modeling. This results in 3 Level A takes for fin whales in Year 1 and 3 Level A takes in Year 2 (total of 6 across both years of foundation installation). Table 33 shows the requested take incidental to foundation installation that is included in the total take request (Section 6.7).

Table 33. Requested take from foundation installation, included in the total take request in Section 6.7.

| | Year 1 | | Year 2 | | Total* | |
|---|---|---|---|---|---|---|
| **Species** | **Level A Take** | **Level B Take** | **Level A Take** | **Level B Take** | **Level A Take** | **Level B Take** |
| ***Mysticetes*** | | | | | | |
| Blue Whale* | - | 1 | - | 1 | - | 2 |
| Fin Whale* | 3 | 39 | 3 | 481 | 6 | 520 |
| Humpback Whale | - | 37 | - | 282 | - | 315 |
| Minke Whale | - | 197 | - | 869 | - | 1,038 |
| North Atlantic Right Whale* | - | 12 | - | 100 | - | 109 |
| Sei Whale* | - | 7 | - | 42 | - | 47 |
| ***Odontocetes*** | | | | | | |
| Atlantic Spotted Dolphin | - | 29 | - | 320 | - | 349 |
| Atlantic White-Sided Dolphin | - | 728 | - | 3,045 | - | 3,566 |
| Bottlenose Dolphin | - | 304 | - | 2,342 | - | 2,610 |
| Common Dolphin | - | 8,553 | - | 41,093 | - | 48,069 |
| Harbor Porpoise | - | 378 | - | 2,382 | - | 2,695 |
| Pilot Whales | - | 61 | - | 635 | - | 696 |
| Risso's Dolphin | - | 37 | - | 1,760 | - | 1,797 |
| Sperm Whale* | - | 13 | - | 122 | - | 135 |
| ***Pinnipeds*** | | | | | | |
| Gray Seal | - | 225 | - | 8,331 | - | 8,541 |
| Harbor Seal | - | 35 | - | 432 | - | 463 |

The Level B take shown in Table 33 for Year 1 and Year 2 includes the maximum exposure estimates for each species from the two or three possible foundation installation scenarios available each year, shown in Section 6.3, except when mean group size or PSO daily sighting rate exceeded the maximum modeled exposure estimate, in which case the largest of these values was used. The total requested take incidental to foundation installation is less than the sum of the two years individually because it is based on a realistic foundation installation scenario in which Project 1 Scenario 1 occurs (71 WTG monopiles and 1 OSP jacket) followed by Project 2 Scenario 2 (73 WTG monopiles and 1 OSP jacket) for a total of 146 foundations. Using the maximum number of foundations that could be installed in Year 2 ensures that Year 2 is the maximum yearly case. However, all five installation scenarios described in Section 6.3 are possible. In particular, Project 1 Scenario 2 plus Project 2 Scenario 3 (147 total foundations) remains a possibility. The 5-year take request uses the former, however, because it results in a greater number of estimated takes.

## 6.4 HRG Surveys – Construction Phase

HRG surveys will take place within the Lease Area as well as along the ECCs. For some species, marine mammal densities may differ between the more nearshore areas along the ECCs and the more offshore location of the Lease Area. For that reason, separate densities were calculated for the two areas and the total anticipated survey effort was similarly split between the two locations as described below.

### *6.4.1 Marine Mammal Densities*

To select marine mammal density grid cells from the Roberts et al. (2016; 2023) data representative of the area around the ECCs, a 5-km (3 mi) perimeter around the ECCs was created in GIS (ESRI 2017). This perimeter was then intersected with the density grid cells to select those near the ECCs. An example of a single species (bottlenose dolphin in the month of August) and how the polygon was used to select the density grid cells is shown in Figure 12. The average density of each species in each month was then calculated from the selected grid cells (Table 34) and an annual average density was calculated by averaging across all 12 months (Table 35).

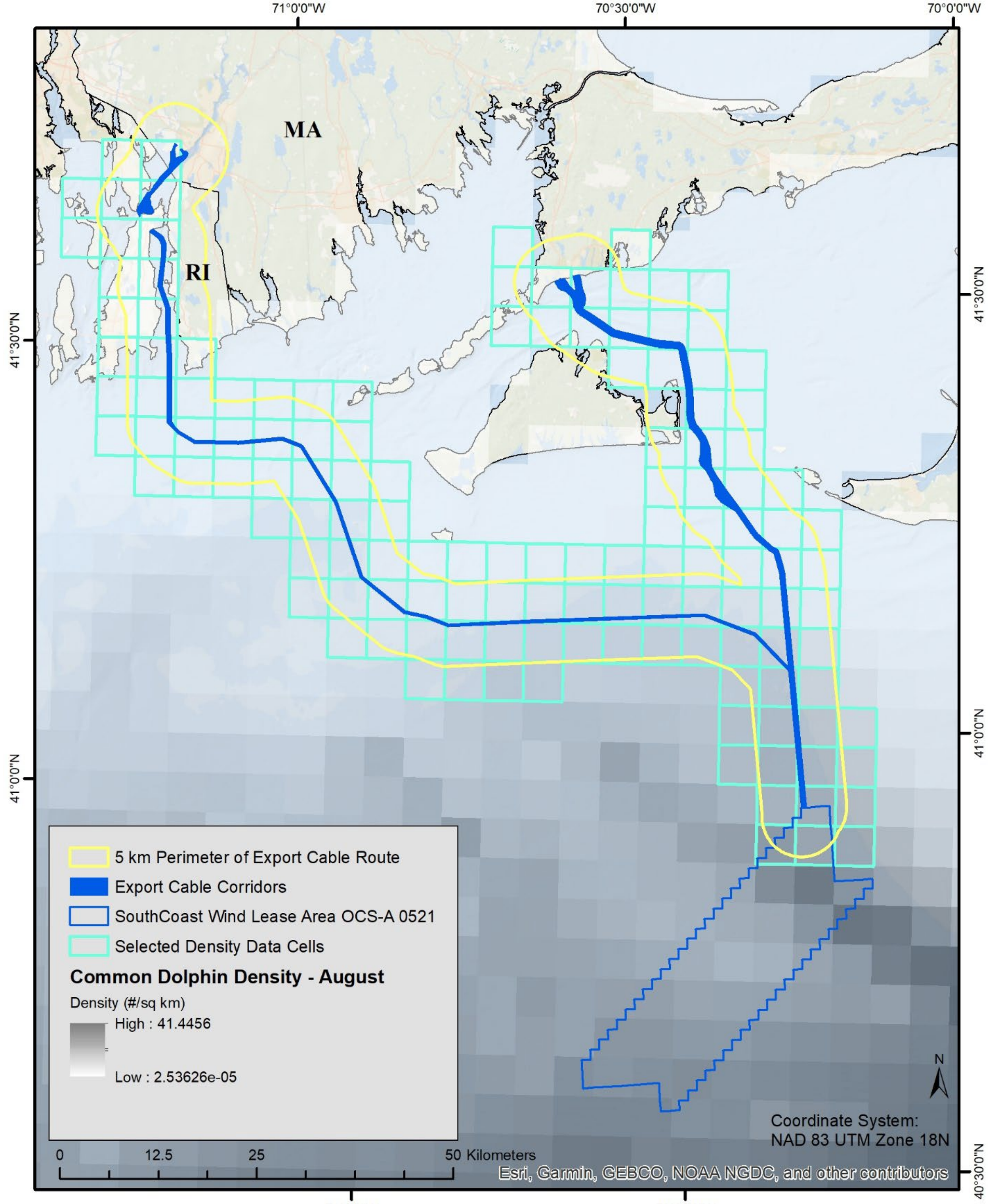

Figure 12. Location of the ECCs and 5 km (3 mi) perimeter used to select the marine mammal density grid cells from Roberts et al. (2016; 2023) for calculating average monthly marine mammal densities.

Table 34. Average monthly marine mammal densities from within 5 km (3 mi) of the ECCs.

| | **Monthly Average Densities (Individuals/km$^2$)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| ***Mysticetes*** | | | | | | | | | | | | |
| Blue Whale* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Fin Whale* | 0.0013 | 0.0005 | 0.0004 | 0.0011 | 0.0013 | 0.0009 | 0.0010 | 0.0009 | 0.0003 | 0.0002 | 0.0004 | 0.0012 |
| Humpback Whale | 0.0004 | 0.0003 | 0.0003 | 0.0007 | 0.0012 | 0.0008 | 0.0006 | 0.0006 | 0.0007 | 0.0008 | 0.0011 | 0.0005 |
| Minke Whale | 0.0010 | 0.0010 | 0.0010 | 0.0058 | 0.0107 | 0.0069 | 0.0029 | 0.0016 | 0.0011 | 0.0013 | 0.0004 | 0.0008 |
| North Atlantic Right Whale* | 0.0048 | 0.0057 | 0.0052 | 0.0043 | 0.0022 | 0.0004 | 0.0002 | 0.0002 | 0.0003 | 0.0005 | 0.0009 | 0.0031 |
| Sei Whale* | 0.0002 | 0.0001 | 0.0002 | 0.0006 | 0.0007 | 0.0001 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 0.0005 | 0.0005 |
| ***Odontocetes*** | | | | | | | | | | | | |
| Atlantic Spotted Dolphin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0002 | 0.0001 | 0.0001 | 0.0000 |
| Atlantic White-Sided Dolphin | 0.0035 | 0.0021 | 0.0019 | 0.0039 | 0.0102 | 0.0062 | 0.0039 | 0.0030 | 0.0053 | 0.0057 | 0.0076 | 0.0065 |
| Bottlenose Dolphin | 0.0005 | 0.0001 | 0.0001 | 0.0005 | 0.0023 | 0.0035 | 0.0040 | 0.0042 | 0.0038 | 0.0033 | 0.0034 | 0.0024 |
| Common Dolphin | 0.0156 | 0.0043 | 0.0044 | 0.0118 | 0.0189 | 0.0328 | 0.0307 | 0.0305 | 0.0255 | 0.0176 | 0.0335 | 0.0358 |
| Harbor Porpoise | 0.0508 | 0.0496 | 0.0461 | 0.0468 | 0.0284 | 0.0104 | 0.0098 | 0.0085 | 0.0073 | 0.0084 | 0.0104 | 0.0442 |
| Pilot Whales | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| Risso’s Dolphin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0004 | 0.0006 |
| Sperm Whale* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0002 | 0.0001 | 0.0003 | 0.0002 | 0.0000 | 0.0001 | 0.0001 |
| ***Pinnipeds*** | | | | | | | | | | | | |
| Gray Seal | 0.2448 | 0.1802 | 0.1574 | 0.2062 | 0.3205 | 0.2968 | 0.0558 | 0.0427 | 0.0678 | 0.1866 | 0.2013 | 0.2298 |
| Harbor Seal | 0.0159 | 0.0117 | 0.0102 | 0.0134 | 0.0208 | 0.0193 | 0.0036 | 0.0028 | 0.0044 | 0.0121 | 0.0131 | 0.0149 |

* Denotes species listed under the Endangered Species Act

Table 35. Annual average marine mammal densities within 5 km (3 mi) of the ECCs.

| Species | Annual Average Density (Ind/km$^2$) |
|---|---|
| ***Mysticetes*** | |
| Blue Whale* | 0.0000 |
| Fin Whale* | 0.0008 |
| Humpback Whale | 0.0007 |
| Minke Whale | 0.0029 |
| North Atlantic Right Whale* | 0.0023 |
| Sei Whale* | 0.0003 |
| ***Odontocetes*** | |
| Atlantic Spotted Dolphin | 0.0000 |
| Atlantic White-Sided Dolphin | 0.0050 |
| Bottlenose Dolphin | 0.0023 |
| Common Dolphin | 0.0218 |
| Harbor Porpoise | 0.0267 |
| Pilot Whales | 0.0002 |
| Risso's Dolphin | 0.0002 |
| Sperm Whale* | 0.0001 |
| ***Pinnipeds*** | |
| Gray Seal | 0.1825 |
| Harbor Seal | 0.0119 |

* Denotes species listed under the Endangered Species Act

To select marine mammal density grid cells from the Roberts et al. (2016; 2023) data representative of the area within and immediately adjacent to the Lease Area, a 5-km (3-mi) perimeter of the Lease Area was created in GIS (ESRI 2017). This perimeter was then intersected with the density grid cells to select cells in and around the Lease Area (Figure 13). The average density of each species in each month was then calculated from the selected grid cells (Table 36) and an annual average density was calculated by averaging across all 12 months (Table 37).

Since HRG surveys may occur at any time of year, the average annual density for each species was selected (Table 35 and Table 37) and used to calculated potential takes from HRG survey that may occur throughout the entire year.

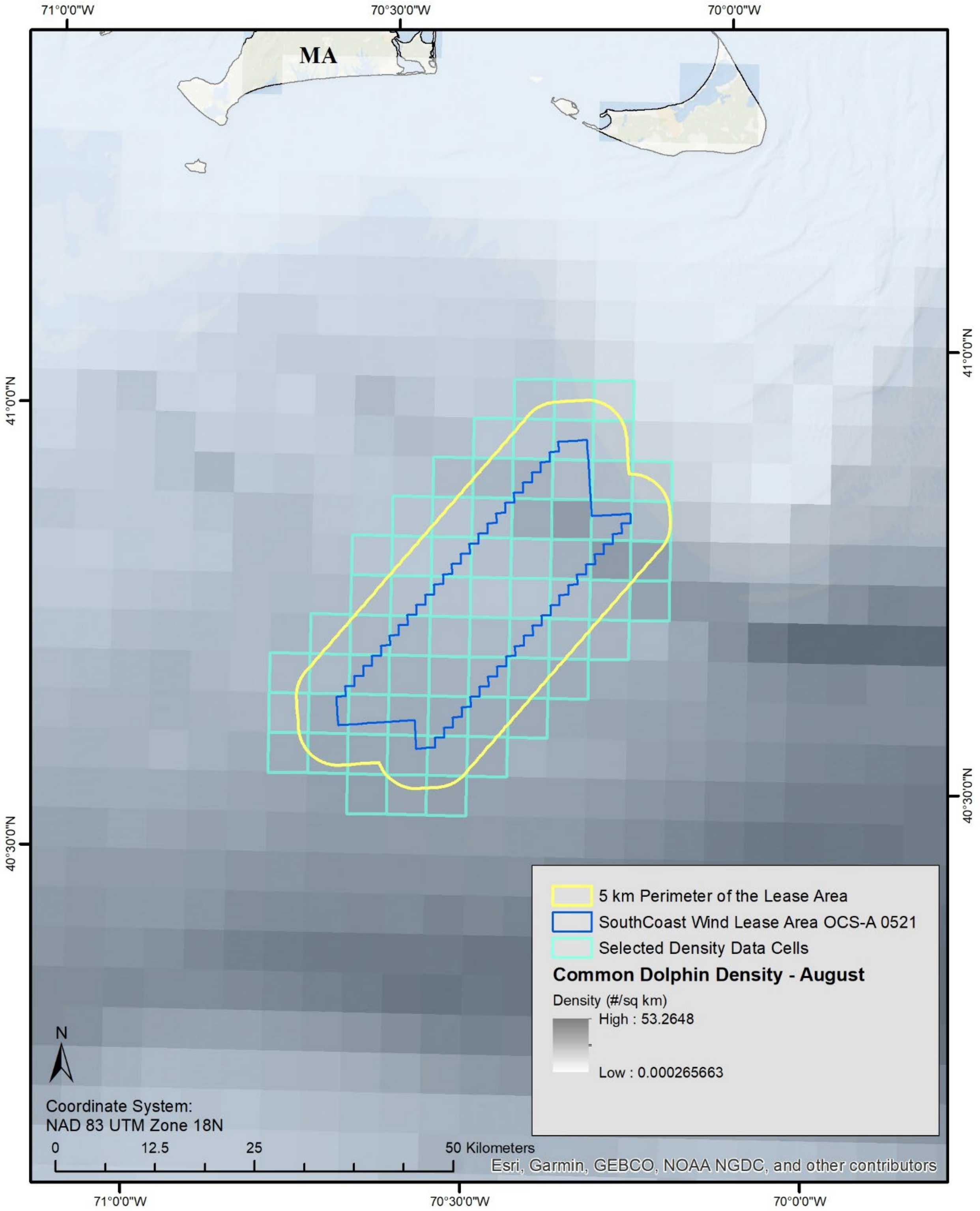

Figure 13. Location of the Lease Area and 5 km (3 mi) perimeter used to select the marine mammal density grid cells from Roberts et al. (2016; 2023) for calculating average monthly marine mammal densities.

Table 36. Average monthly marine mammal densities from within 5 km (3 mi) of the Lease Area.

| | **Monthly Average Densities (Individuals/km$^2$)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| ***Mysticetes*** | | | | | | | | | | | | |
| Blue Whale* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Fin Whale* | 0.0022 | 0.0018 | 0.0015 | 0.0015 | 0.0030 | 0.0029 | 0.0047 | 0.0036 | 0.0027 | 0.0009 | 0.0005 | 0.0014 |
| Humpback Whale | 0.0003 | 0.0002 | 0.0005 | 0.0018 | 0.0031 | 0.0035 | 0.0021 | 0.0012 | 0.0017 | 0.0025 | 0.0020 | 0.0003 |
| Minke Whale | 0.0011 | 0.0013 | 0.0014 | 0.0075 | 0.0151 | 0.0175 | 0.0080 | 0.0048 | 0.0053 | 0.0050 | 0.0005 | 0.0007 |
| North Atlantic Right Whale* | 0.0054 | 0.0060 | 0.0054 | 0.0050 | 0.0037 | 0.0007 | 0.0004 | 0.0003 | 0.0004 | 0.0006 | 0.0011 | 0.0033 |
| Sei Whale* | 0.0004 | 0.0002 | 0.0005 | 0.0012 | 0.0019 | 0.0006 | 0.0002 | 0.0001 | 0.0002 | 0.0004 | 0.0009 | 0.0007 |
| ***Odontocetes*** | | | | | | | | | | | | |
| Atlantic Spotted Dolphin | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0004 | 0.0006 | 0.0005 | 0.0008 | 0.0043 | 0.0068 | 0.0017 | 0.0002 |
| Atlantic White-Sided Dolphin | 0.0263 | 0.0158 | 0.0111 | 0.0169 | 0.0368 | 0.0380 | 0.0204 | 0.0087 | 0.0193 | 0.0298 | 0.0225 | 0.0321 |
| Bottlenose Dolphin | 0.0051 | 0.0012 | 0.0008 | 0.0022 | 0.0097 | 0.0162 | 0.0176 | 0.0200 | 0.0198 | 0.0181 | 0.0160 | 0.0129 |
| Common Dolphin | 0.0933 | 0.0362 | 0.0320 | 0.0474 | 0.0799 | 0.1721 | 0.1549 | 0.2008 | 0.3334 | 0.3331 | 0.1732 | 0.1467 |
| Harbor Porpoise | 0.1050 | 0.1135 | 0.1081 | 0.0935 | 0.0720 | 0.0174 | 0.0174 | 0.0155 | 0.0165 | 0.0203 | 0.0219 | 0.0675 |
| Pilot Whales | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 |
| Risso's Dolphin | 0.0005 | 0.0001 | 0.0000 | 0.0002 | 0.0014 | 0.0010 | 0.0013 | 0.0028 | 0.0035 | 0.0017 | 0.0015 | 0.0019 |
| Sperm Whale* | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0002 | 0.0003 | 0.0005 | 0.0017 | 0.0009 | 0.0006 | 0.0004 | 0.0003 |
| ***Pinnipeds*** | | | | | | | | | | | | |
| Gray Seal | 0.1812 | 0.1783 | 0.1277 | 0.1154 | 0.1520 | 0.0227 | 0.0059 | 0.0050 | 0.0086 | 0.0196 | 0.0750 | 0.1520 |
| Harbor Seal | 0.0118 | 0.0116 | 0.0083 | 0.0075 | 0.0099 | 0.0015 | 0.0004 | 0.0003 | 0.0006 | 0.0013 | 0.0049 | 0.0099 |

* Denotes species listed under the Endangered Species Act

Table 37. Annual average marine mammal densities within 10 km (6.2 mi) of the Lease Area.

| Species | Annual Average Density (Ind./km$^2$) |
|---|---|
| ***Mysticetes*** | |
| Blue Whale* | 0.0000 |
| Fin Whale* | 0.0022 |
| Humpback Whale | 0.0016 |
| Minke Whale | 0.0057 |
| North Atlantic Right Whale* | 0.0027 |
| Sei Whale* | 0.0006 |
| ***Odontocetes*** | |
| Atlantic Spotted Dolphin | 0.0013 |
| Atlantic White-Sided Dolphin | 0.0231 |
| Bottlenose Dolphin | 0.0116 |
| Common Dolphin | 0.1503 |
| Harbor Porpoise | 0.0557 |
| Pilot Whales | 0.0029 |
| Risso's Dolphin | 0.0013 |
| Sperm Whale* | 0.0005 |
| ***Pinnipeds*** | |
| Gray Seal | 0.0869 |
| Harbor Seal | 0.0056 |

* Denotes species listed under the Endangered Species Act

### 6.4.2 Area Potentially Exposed to Sounds Above Threshold Levels from HRG Surveys-Construction Phase

As described in Section 1.2 of this request, only some of the in-water equipment planned for use during this survey produces sounds audible to marine mammals. This includes sparkers, boomers, sub-bottom profilers, single-beam echosounders, and USBL systems. The single-beam echosounders and USBL systems are necessary for navigational and equipment positioning purposes which are activities for which NMFS does not require authorization, so they are not considered further in this section. Equipment that operates in the water but outside the range of marine mammal hearing, at or above 180 kHz, includes the multi-beam echosounders and sidescan sonars, none of which are considered further in this section.

#### 6.4.2.1 Level A

Table 38 provides details on representative geophysical survey equipment that may be used by SouthCoast Wind and could result in the taking of marine mammals. Methods used to estimate distances to threshold levels are described in Appendix B. The calculations are based on a combination of manufacturer provided source levels and operational parameters for the specific equipment as recommended by NMFS (2020) as well as source level and directional measurements of similar equipment reported by Crocker and Fratantonio (2016).

### Sparkers

One of the sparker systems that may be used during the HRG surveys, the Applied Acoustics Dura-Spark, was measured by Crocker and Fratantonio (2016) but not with an energy setting near 800 J (typical energy setting for HRG surveys). A similar alternative system, the SIG ELC 820 sparker, was measured with an input voltage of 750 J so that has been used as a surrogate as recommended by NMFS. As a conservative approach, the SIG ELC 820 sparker was assumed to be an omni directional source. Using these inputs, the distance to the high-frequency cetacean $\mathrm{SEL_{cum}}$ threshold was estimated to be 8 m (26 ft) while the distance to the $\mathrm{SPL_{peak}}$ threshold was estimated to be 4 m (13 ft) (Table 38). Distances to threshold criteria for all other hearing groups were either negligible or not reached.

Table 38. Estimated distances to Level A take thresholds for the planned HRG survey equipment.

| Equipment Type | Representative System(s) | Operating Frequency (kHz) | Source Level | Distance (m) to Level A Threshold (pk / cum) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | LFC | MFC | HFC | PPW | OPW |
| Sparker | SIG ELC 820 @ 750 J | 0.01 – 1.9 | 213 $\mathrm{dB_{peak}}$<br>203 $\mathrm{dB_{rms}}$ | – / 1 | – / <1 | 4 / <1 | – / <1 | – / <1 |
| Sub-bottom Profiler | Teledyne Benthos Chirp III | 2 – 7 | 204 $\mathrm{dB_{peak}}$<br>199 $\mathrm{dB_{rms}}$ | – / 2 | – / <1 | – / 57 | – / 1 | – / <1 |
| Boomer | Applied Acoustics S-boom @ 700 J | 0.01 – 5 | 211 $\mathrm{dB_{peak}}$<br>205 $\mathrm{dB_{rms}}$ | – / <1 | – / <1 | 1 / <1 | – / <1 | – / <1 |

"NA" Not Applicable as there are no $\mathrm{SPL_{peak}}$ threshold criteria for intermittent sources.

"–" Indicates the HRG equipment source level is below the relevant threshold level.

### Sub-bottom Profilers

The Teledyne Benthos Chirp III has the highest source level, so it was also selected as a representative sub-bottom profiling system. Crocker and Fratantonio (2016) measured source levels of a similar device, the Knudsen 3202 Chirp sub-bottom profiler, at several different power settings. The strongest power settings measured were determined to be applicable to a hull-mounted system, while the lowest power settings were determined to be applicable to the towfish version that may be used by SouthCoast Wind. The measured source level for the Knudsen 3202 at low power with an 8 millisecond pulse width was 199 dB $\mathrm{SPL_{rms}}$ and a beamwidth of 82° (Crocker and Fratantonio 2016). Using the inputs from Crocker and Fratantonio (2016), this type of sub-bottom profiler system is expected to result in very short distances to Level A thresholds for all hearing groups except the high-frequency cetaceans, for which the $\mathrm{SEL_{cum}}$ distance is 57 m (187 ft) (Table 38).

### Boomer

Crocker and Fratantonio (2016) measured several different Boomer systems, including the Applied Acoustics S-Boom, which is the same model that may be used during the SouthCoast Wind HRG surveys. The source level measurements in Crocker and Fratantonio (2016) for the Applied Acoustics S-boom resulted in an estimated distance of <1 m to the high-frequency cetacean $\mathrm{SEL_{cum}}$ threshold and an estimated distance of 1 m to the $SPL_{peak}$ threshold (Table 38). Distances to Level A thresholds for all other hearing groups were negligible or not reached.

### Level A Take Summary

The largest distance to a Level A threshold from a sparker, sub-bottom profiler, or boomer source is anticipated to be 57 m (187 ft) for high-frequency cetaceans and less than 10 m (33 ft) for all other hearing groups (Table 38). The only high-frequency cetacean species present in this region is the harbor porpoise. Harbor porpoise are known to largely avoid vessels and anthropogenic sounds; thus, even in the absence of the mitigation measures proposed in Section 11, the potential for Level A harassment of this or any other species is very unlikely. Therefore, no Level A takes from HRG surveys are expected or are being requested.

## *6.4.2.2 Level B*

In April, 2020, NMFS issued interim guidance for calculating distances to the 160 dB $SPL_{rms}$ Level B threshold from HRG sources (NMFS 2020e). The recommendations provided specific equations for incorporating absorption loss at higher frequencies and accounting for narrow beamwidths and angles when calculating transmission loss from equipment source levels. Due to substantial variability in back-propagated source levels calculated from field verification measurements received by NMFS, the recommendations also stated that source levels in Crocker and Fratantonio (2016) should be used when the same equipment measured in that study are planned for use. If different makes or models of similar equipment are used, then the guidance stated that manufacturer provided source levels should be used in the calculations. The following sections summarize the parameters used to estimate the 160 dB $SPL_{rms}$ threshold range for each piece of equipment based on the July 2020 NMFS guidance including additional adjustments for seawater absorption and out-of-beam or side-lobe energy produced by the equipment as described in Appendix B.

### Sparkers

The measured source level of the SIG ELC 820 sparker at 5 m (16 ft) water depth with an input voltage of 750 J was 203 dB $SPL_{rms}$ ((Table 9 *in* Crocker and Fratantonio (2016)). Using this source level and assuming it is an omnidirectional source (180° beamwidth), the calculated horizontal distance to the 160 dB $SPL_{rms}$ threshold is 141 m (463 ft) (Table 39; Appendix B).

### Sub-bottom Profilers

For the Teledyne Benthos Chirp III with a 199 dB $SPL_{rms}$ source level and the recommended adjustments for frequency and beamwidth, the calculated horizontal distance to the 160 dB $SPL_{rms}$ threshold is 66 m (217 ft) (Table 39).

### Boomer

The measured source level of the Applied Acoustics S-Boom with an input voltage of 700 J was 205 dB $SPL_{rms}$ (Crocker and Fratantonio 2016). Using this source level and assuming it has a 61° beamwidth, the calculated horizontal distance to the 160 dB $SPL_{rms}$ threshold is 90 m (Table 39).

Table 39. Estimated distances to Level B take thresholds for the planned survey equipment.

| Equipment Type | Representative System(s) | Operating Frequency (kHz) | Source Level (dB rms) | Out-of-Beam Source Level (dB rms) | Beamwdith (degrees) | Distance to Level B Threshold (m) |
|---|---|---|---|---|---|---|
| Sparker | SIG ELC 820 @ 750 J | 0.01 – 1.9 | 203 | N/A | 180 | 141 |
| Sub-bottom Profiler | Teledyne Benthos Chirp III | 2 – 7 | 199 | 196 | 82 | 66 |
| Boomer | Applied Acoustics S-boom @ 700 J | 0.01 – 5 | 205 | N/A | 61 | 90 |

**Level B Area Ensonified**

The largest modeled distance to the Level B threshold from HRG survey equipment was 141 m (463 ft) from a sparker. Although a sparker may not be used at all times during HRG surveys, this distance was used in calculating the area exposed to sounds above 160 dB $SPL_{rms}$ for all HRG survey activity. This was done by assuming an average of 80 km (50 mi) of survey activity would be completed daily by each survey vessel when active. A 141 m (463 ft) perimeter around 80 km (50 mi) of survey line was calculated to estimate a daily ensonified area of 22.6 $km^2$ (8.7 $mi^2$).

During construction, it is estimated that 4,000 km (2,485.5 mi) of HRG surveys will occur within the Lease Area and 5,000 km (3,106.8 mi) will occur along the ECCs. Assuming 80 km (50 mi) is surveyed per day, that results in 50 days of survey activity in the Lease Area and 62.5 days of survey activity along the ECCs. Multiplying the daily ensonified area by the number of days of survey activity within each area results in a total ensonified area of 1,130 $km^2$ (702.1 $mi^2$) in the Lease Area and 1,412.5 $km^2$ (877.7 $mi^2$) along the ECCs.

### *6.4.3 Exposure and Take Estimates from HRG Surveys- Construction Phase*

To calculate exposure and take estimates from HRG surveys within the Lease Area during construction, the annual average marine mammal densities in Table 37 were multiplied by the total ensonified area expected within the Lease Area and the results are shown in the LA column in Table 40. The same calculation was performed for the ECCs using marine mammal densities in Table 35 and the results are shown in the ECC column of Table 40. The construction HRG takes for the LA and ECC were partitioned into Year 1 and Year 2 based on the number of foundations that could be installed in each year, with proportions of 72/146 foundations for Project 1 and 74/146 foundations for Project 2. This was based on the realistic foundation installation scenario of Project 1 Scenario 1 and Project 2 Scenario 2 as used in the 5-year total take estimate. No Level A takes for this activity are anticipated or requested. The requested Level B takes incidental to HRG surveys during the 2-year construction phase are shown in the last two columns of Table 40. These numbers were carried forward to the total take request in Section 6.7.

Table 40. Level B exposure[1] and take estimates from HRG surveys during construction. LA = Lease Area, ECC = Export Cable Corridor.

| | Construction Phase Density-based Exposures by Survey Area - Year 1 | | | Construction Phase Density-based Exposures by Survey Area - Year 2 | | | PSO Data Based Estimate | Mean Group Size | Year 1 Level B Take | Year 2 Level B Take |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **LA** | **ECC** | **Total** | **LA** | **ECC** | **Total** | | | | |
| ***Mysticetes*** | | | | | | | | | | |
| Blue Whale* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 1.0 | 1 | 1 |
| Fin Whale* | 1.2 | 0.6 | 1.8 | 1.3 | 0.6 | 1.8 | 5.3 | 1.8 | 6 | 6 |
| Humpback Whale | 0.9 | 0.5 | 1.4 | 0.9 | 0.5 | 1.4 | 51.4 | 2.0 | 52 | 52 |
| Minke Whale | 3.2 | 2.0 | 5.2 | 3.3 | 2.1 | 5.3 | 10.2 | 1.4 | 11 | 11 |
| North Atlantic Right Whale* | 1.5 | 1.6 | 3.1 | 1.5 | 1.7 | 3.2 | - | 2.4 | 4 | 4 |
| Sei Whale* | 0.3 | 0.2 | 0.5 | 0.4 | 0.2 | 0.6 | 1.4 | 1.6 | 2 | 2 |
| ***Odontocetes*** | | | | | | | | | | |
| Atlantic Spotted Dolphin | 0.7 | 0.0 | 0.7 | 0.7 | 0.0 | 0.8 | - | 29.0 | 29 | 29 |
| Atlantic White-Sided Dolphin | 12.9 | 3.5 | 16.4 | 13.3 | 3.6 | 16.8 | - | 27.9 | 28 | 28 |
| Bottlenose Dolphin | 6.5 | 1.6 | 8.1 | 6.7 | 1.7 | 8.3 | 133.4 | 12.3 | 134 | 134 |
| Common Dolphin | 83.8 | 15.2 | 99.0 | 86.1 | 15.6 | 101.8 | 1,165.5 | 34.9 | 1,166 | 1,166 |
| Harbor Porpoise | 31.1 | 18.6 | 49.7 | 31.9 | 19.1 | 51.1 | 0.2 | 2.7 | 50 | 52 |
| Pilot Whales | 1.6 | 0.1 | 1.8 | 1.7 | 0.1 | 1.8 | 5.9 | 10.3 | 11 | 11 |
| Risso's Dolphin | 0.7 | 0.1 | 0.9 | 0.8 | 0.1 | 0.9 | - | 5.4 | 6 | 6 |
| Sperm Whale* | 0.3 | 0.1 | 0.3 | 0.3 | 0.1 | 0.3 | 0.4 | 2.0 | 2 | 2 |
| ***Pinnipeds*** | | | | | | | | | | |
| Gray Seal | 48.5 | 127.2 | 175.7 | 49.8 | 130.8 | 180.6 | 3.1 | 1.4 | 176 | 181 |
| Harbor Seal | 3.1 | 8.3 | 11.4 | 3.2 | 8.5 | 11.7 | 48.3 | 1.4 | 49 | 49 |

* Denotes species listed under the Endangered Species Act.

[1] Exposure estimates are presented here with a single decimal place for readability. Due to rounding, the total yearly density-based exposures may not equal the sum of the LA and ECC exposures.

## 6.5 HRG Surveys – Operations Phase

HRG surveys will be carried out on a routine basis during the 3 years of operations (following ~2 years of construction) expected under the requested incidental take regulations (5-year LOA effective period). Potential takes for these HRG surveys during the operations phase were calculated using the same approach as described for the construction phase but assume a reduced level of survey effort on an annual basis as described below.

### *6.5.1 Marine Mammal Densities*

The same annual average densities in the Lease Area (Table 37) and ECCs (Table 35) used to calculate potential takes from HRG surveys during the construction phase were used to calculate potential takes from HRG surveys during the operations phase.

### *6.5.2 Area Potentially Exposed to Sounds Above Threshold Levels from HRG Surveys-Operations Phase*

On an annual basis during operations, it is estimated that 2,800 km (1,739.8 mi) of HRG surveys will occur within the Lease Area and 3,200 km (1,988.4 mi) will occur within the ECCs. Assuming 80 km (50 mi) is surveyed per day results in 35 days of survey activity in the Lease Area and 40 days of survey activity with the ECCs each year. Multiplying the daily ensonified area by the number of days of survey activity within each area results in an annual ensonified area of 791 $km^2$ (491.5 $mi^2$) in the Lease Area and 904 $km^2$ (561.7 $mi^2$) with the ECCs. Over the three years of operations that would occur during the five-year period covered by the requested regulations, the total ensonified area in the Lease Area would be 2,373 $km^2$ (1,474.5 $mi^2$) and within the ECCs would be 2,712 $km^2$ (1,685.2 $mi^2$).

### 6.5.3 Exposure and Take Estimates from HRG Surveys- Operations Phase

The density-based take estimate for one year during the operations phase was calculated for the Lease Area and ECCs in the same manner as described in Section 6.4.3. This value was then compared against the PSO data take estimate and the mean group size of each species and the largest value was selected as the annual estimated take during operations (Table 41). The annual estimated take was then multiplied by three to calculate the total take over the three years of operations. No Level A takes for this activity are anticipated or requested. The requested Level B takes incidental to HRG surveys during the 3-year operations phase are shown in the last two columns of Table 41. The “Highest Annual Estimated Level B Take” was used for each of Year 3, Year 4, and Year 5 of the yearly take request in Section 6.7 and the “3-year Estimated Level B Take” was used in the 5-year total take requestion in Section 6.7.

Table 41. Level B exposure[1] and take estimates from HRG surveys during operations. LA = Lease Area, ECC = Export Cable Corridor.

| | Annual Operations Phase Exposures by Survey Area | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **LA** | **ECC** | **Annual Total Density-based Exposures** | **Annual PSO Data Based Estimate** | **Mean Group Size** | **Highest Annual Estimated Level B Take** | **3-year Estimated Level B Take** |
| ***Mysticetes*** | | | | | | | |
| Blue Whale* | 0.0 | 0.0 | 0.0 | - | 1.0 | 1 | 3 |
| Fin Whale* | 1.8 | 0.7 | 2.5 | 3.6 | 1.8 | 4 | 12 |
| Humpback Whale | 1.3 | 0.6 | 1.9 | 34.3 | 2.0 | 35 | 105 |
| Minke Whale | 4.5 | 2.6 | 7.1 | 6.8 | 1.4 | 8 | 24 |
| North Atlantic Right Whale* | 2.1 | 2.1 | 4.2 | - | 2.4 | 5 | 15 |
| Sei Whale* | 0.5 | 0.3 | 0.7 | 0.9 | 1.6 | 2 | 6 |
| ***Odontocetes*** | | | | | | | |
| Atlantic Spotted Dolphin | 1.0 | 0.0 | 1.1 | - | 29.0 | 29 | 87 |
| Atlantic White-Sided Dolphin | 18.3 | 4.5 | 22.8 | - | 27.9 | 28 | 84 |
| Bottlenose Dolphin | 9.2 | 2.1 | 11.3 | 88.9 | 12.3 | 89 | 267 |
| Common Dolphin | 119.0 | 19.7 | 138.7 | 777.0 | 34.9 | 778 | 2,334 |
| Harbor Porpoise | 44.1 | 24.2 | 68.3 | 0.1 | 2.7 | 69 | 207 |
| Pilot Whales | 2.3 | 0.1 | 2.5 | 3.9 | 10.3 | 11 | 33 |
| Risso’s Dolphin | 1.1 | 0.1 | 1.2 | - | 5.4 | 6 | 18 |
| Sperm Whale* | 0.4 | 0.1 | 0.5 | 0.3 | 2.0 | 2 | 6 |
| ***Pinnipeds*** | | | | | | | |
| Gray Seal | 68.8 | 165.1 | 234.0 | 2.1 | 1.4 | 234 | 702 |
| Harbor Seal | 4.5 | 10.7 | 15.2 | 32.2 | 1.4 | 33 | 99 |

* Denotes species listed under the Endangered Species Act.

[1] Exposure estimates are presented here with a single decimal place for readability. Due to rounding, the total yearly density-based exposures may not equal the sum of the LA and ECC exposures.

## 6.6 UXO Detonations

For UXOs that are positively identified in proximity to planned activities on the seabed, several alternative strategies will be considered prior to detonating the UXO in place. These may include relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would a decision to detonate the UXO in place be made. To detonate a UXO, a small charge would be placed on the UXO and detonated causing the UXO itself to then detonate.

The exact number and type of UXOs in the Project Area are not yet known. As a conservative approach, it is currently assumed that up to 5 UXOs in the Lease Area and up to 5 along the ECCs may have to be detonated in place. To avoid times when sensitive marine mammal species are more likely to be present, UXO detonations are only planned to occur during the months from May through November.

### *6.6.1 Marine Mammal Densities*

UXO detonations would not occur during the months from December through April. Since detonations would likely occur within a relatively short period of time (e.g. one month), using the annual average densities calculated for HRG surveys may underestimate the actual densities of some species during the month that detonations actually take place. Instead, the highest average monthly density for each species from May through November from within 15 km (9.3 mi) of the ECCs and Lease Area was selected and used in the estimates of potential take. The 15 km distance was used when calculating average densities because the largest distances to behavioral disturbance thresholds were between 10 km and 15 km (see Section 6.6.2). The maximum monthly densities and the months from which they came are shown in Table 42 for the ECCs and Table 43 for the Lease Area.

Table 42. Maximum average monthly marine mammal densities along the ECC from May through November and the month in which the maximum density occurs for each species.

| **Species** | **Maximum Monthly Density (Ind/km$^2$)** | **Maximum Density Month** |
|---|---|---|
| ***Mysticetes*** | | |
| Blue Whale* | 0.0000 | Annual |
| Fin Whale* | 0.0013 | May |
| Humpback Whale | 0.0012 | May |
| Minke Whale | 0.0107 | May |
| North Atlantic Right Whale* | 0.0022 | May |
| Sei Whale* | 0.0007 | May |
| ***Odontocetes*** | | |
| Atlantic Spotted Dolphin | 0.0002 | September |
| Atlantic White-Sided Dolphin | 0.0102 | May |
| Bottlenose Dolphin | 0.0042 | August |
| Common Dolphin | 0.0335 | November |
| Harbor Porpoise | 0.0284 | May |
| Pilot Whales | 0.0002 | Annual |
| Risso's Dolphin | 0.0004 | November |
| Sperm Whale* | 0.0003 | August |
| ***Pinnipeds*** | | |
| Gray Seal | 0.3205 | May |
| Harbor Seal | 0.0208 | May |

* Denotes species listed under the Endangered Species Act

Table 43. Maximum average monthly marine mammal densities within the Lease Area from May through November and the month in which the maximum density occurs for each species.

| Species | Maximum Monthly Density (Ind/km$^2$) | Maximum Density Month |
|---|---|---|
| ***Mysticetes*** | | |
| Blue Whale* | 0.0000 | Annual |
| Fin Whale* | 0.0047 | July |
| Humpback Whale | 0.0035 | June |
| Minke Whale | 0.0175 | June |
| North Atlantic Right Whale* | 0.0037 | May |
| Sei Whale* | 0.0019 | May |
| ***Odontocetes*** | | |
| Atlantic Spotted Dolphin | 0.0068 | October |
| Atlantic White-Sided Dolphin | 0.0380 | June |
| Bottlenose Dolphin | 0.0200 | August |
| Common Dolphin | 0.3334 | September |
| Harbor Porpoise | 0.0720 | May |
| Pilot Whales | 0.0029 | Annual |
| Risso's Dolphin | 0.0035 | September |
| Sperm Whale* | 0.0017 | August |
| ***Pinnipeds*** | | |
| Gray Seal | 0.1520 | May |
| Harbor Seal | 0.0099 | May |

* Denotes species listed under the Endangered Species Act

### *6.6.2 Area Potentially Exposed to Sounds Above Threshold Levels from UXO Detonations*

The type and net explosive weight of UXOs that may be detonated are not known at this time. To capture a range of potential UXOs, five categories or "bins" of net explosive weight established by the U.S. Navy (2017) were selected for acoustic modeling Table 44. Sound propagation away from detonations is affected by acoustic reflections from the sea surface and seabed. Water depth and seabed properties will influence the sound exposure levels and sound pressure levels at distance from detonations. Their influence is complex but can be predicted accurately by acoustic models. Such modeling was conducted at five sites that are part of the SouthCoast Wind Project (two along the eastern ECC, one on the western ECC, and two in the Lease Area). The modelled water depths at each site range from 45-60 m in the Lease Area and 10-30 m in the two ECCs. Exact locations for the modeling sites are shown in Figure 1 of (Hannay and Zykov 2022).

Table 44. Navy "bins" and corresponding maximum charge weights (equivalent TNT) modeled.

| Navy Bin Designation | Maximum Equivalent Weight (TNT) | |
|---|---|---|
| | kg | lbs |
| E4 | 2.3 | 5 |
| E6 | 9.1 | 20 |
| E8 | 45.5 | 100 |
| E10 | 227 | 500 |
| E12 | 454 | 1000 |

Modeling of acoustic fields generated by UXO detonations was performed using a combination of semi-empirical and physics-based computational models. The source pressure function used for estimating PK and impulse ($J_p$) metrics was calculated with an empirical model that approximates the rapid conversion (within approximately 1 microsecond 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. 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. This initial empirical model is only valid close to the source (within tens of meters), so alternative formulae were used beyond those distances to a point where the sound pressure decay with range transitions to the spherical spreading model.

The calculation of SEL and SPL levels is dependent on the entire pressure waveform, including the initial shock pulse (described above) and the subsequent oscillation of the gas bubble. The negative phase pressure troughs and bubble pulse peaks following the shock pulse are responsible for most of the low frequency energy of the overall waveform. The SEL and SPL thresholds for injury and disturbance occur at distances of many water depths in the relatively shallow waters of the Project. As a results, the sound field becomes increasingly influenced by the contributions of sound energy reflected from the sea surface and sea bottom multiples times. To account for this, the modeling was carried out in decidecade frequency bands using the marine operation noise model (MONM, JASCO Applied Sciences). This model applied a parabolic equation approach for frequencies below 4 kHz and a Gaussian beam ray trace model at higher frequencies. In this location, sound speed profiles change little with depth, so these environments do not have strong seasonal dependence. The propagation modeling was performed using a sound speed profile representative of September, which is slightly downward refracting and therefore conservative, and also represents the most likely time of year for UXO removal activities. Additional technical details of the modeling methods, assumptions and environmental parameters used as inputs can be found in Hannay et al. (2022).

A NAS similar to those described for monopile foundation installations is planned to be used during any UXO detonations. Use of a NAS is expected to achieve at least the same 10 dB of attenuation assumed for foundation installation. This is based on an assessment of UXO-clearance activity in European waters summarized by Bellmann and Betke (2021) and has been assumed in the estimated distances to thresholds summarized below.

As described in Section 6.2, potential impacts to marine mammals from underwater explosions are assessed using separate criteria for mortality, non-auditory injury, gastrointestinal injury, auditory injury, and behavioral responses. Since marine mammal densities representative of the ECC were calculated from the area overlapping with UXO acoustic modeling Sites 3–5 in Hannay et al. 2022 and there is relatively little difference between the results from those three sites, the largest range to the thresholds from Site 3–5 was selected for each UXO size class and marine mammal size class or hearing group for use here. The same approach was taken to identify ranges to thresholds for the Lease Area from Sites 1 and 2 in Hannay et al. 2022. In all cases, distances to mortality (Table 45 and Table 46), non-auditory lung injury (Table 47 and Table 48), and gastrointestinal injury (Table 49) thresholds were shorter than to auditory injury thresholds (Table 50 and Table 51). Since the mitigation and monitoring measures described in Section 11 are designed to avoid mortality or non-auditory injuries as well as potential auditory injury for most species, only the auditory injury (PTS) threshold distances are used here for the calculation of potential Level A takes.

Table 45. Ranges (in meters) to the onset of mortality thresholds along the ECC for five UXO size classes assuming 10 dB of attenuation from use of a NAS. Thresholds are based on animal mass and submersion depth (see Section 6.2 and Hannay et al. 2022).

| | $R_{95\%}$ Distance (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E4 | | E6 | | E8 | | E10 | | E12 | |
| **Hearing Group** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** |
| Baleen and Sperm Whales | 5 | 5 | 6 | 5 | 23 | 6 | 69 | 22 | 108 | 34 |
| Pilot and Minke Whales | 5 | 5 | 11 | 5 | 36 | 11 | 106 | 36 | 157 | 58 |
| Beaked Whales | 7 | 5 | 20 | 8 | 60 | 29 | 160 | 86 | 220 | 132 |
| Dolphins, *Kogia* , Pinnipdes | 14 | 6 | 39 | 18 | 108 | 56 | 233 | 151 | 308 | 210 |
| Porpoises | 17 | 7 | 46 | 21 | 119 | 64 | 257 | 167 | 329 | 231 |

Table 46. Ranges (in meters) to the onset of mortality thresholds in the Lease Area for five UXO size classes assuming 10 dB of attenuation from use of a NAS. Thresholds are based on animal mass and submersion depth (see Section 6.2 and Hannay et al. 2022).

| | $R_{95\%}$ Distance (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E4 | | E6 | | E8 | | E10 | | E12 | |
| **Hearing Group** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** |
| Baleen and Sperm Whales | 5 | 5 | 5 | 5 | 18 | 5 | 63 | 18 | 108 | 29 |
| Pilot and Minke Whales | 5 | 5 | 9 | 5 | 28 | 9 | 105 | 30 | 164 | 50 |
| Beaked Whales | 5 | 5 | 15 | 7 | 50 | 23 | 164 | 83 | 240 | 134 |
| Dolphins, *Kogia* , Pinnipdes | 11 | 5 | 26 | 14 | 106 | 44 | 253 | 155 | 345 | 228 |
| Porpoises | 12 | 6 | 28 | 16 | 121 | 56 | 280 | 174 | 368 | 253 |

Table 47. Ranges (in meters) to the onset of non-auditory lung injury thresholds along the ECC for five UXO size classes assuming 10 dB of attenuation from use of a NAS. Thresholds are based on animal mass and submersion depth (see Section 6.2 and Hannay et al. 2022).

| | $R_{95\%}$ Distance (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E4 | | E6 | | E8 | | E10 | | E12 | |
| **Hearing Group** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** |
| Baleen and Sperm Whales | 6 | 5 | 17 | 5 | 54 | 16 | 153 | 51 | 132 | 81 |
| Pilot and Minke Whales | 10 | 5 | 28 | 8 | 83 | 28 | 221 | 84 | 310 | 130 |
| Beaked Whales | 17 | 8 | 46 | 22 | 134 | 67 | 310 | 186 | 413 | 267 |
| Dolphins, *Kogia* , Pinnipdes | 35 | 16 | 88 | 43 | 223 | 126 | 441 | 298 | 557 | 399 |
| Porpoises | 42 | 19 | 103 | 50 | 248 | 144 | 278 | 325 | 594 | 429 |

Table 48. Ranges (in meters) to the onset of non-auditory lung injury thresholds in the Lease Area for five UXO size classes assuming 10 dB of attenuation from use of a NAS. Thresholds are based on animal mass and submersion depth (see Section 6.2 and Hannay et al. 2022).

| | $R_{95\%}$ Distance (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E4 | | E6 | | E8 | | E10 | | E12 | |
| **Hearing Group** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** | **Calf/Pup** | **Adult** |
| Baleen and Sperm Whales | 5 | 5 | 14 | 5 | 45 | 13 | 156 | 44 | 242 | 78 |
| Pilot and Minke Whales | 8 | 5 | 22 | 7 | 78 | 23 | 235 | 80 | 342 | 132 |
| Beaked Whales | 14 | 6 | 36 | 18 | 135 | 59 | 342 | 193 | 471 | 290 |
| Dolphins, *Kogia* , Pinnipdes | 26 | 13 | 83 | 34 | 236 | 126 | 497 | 326 | 639 | 452 |
| Porpoises | 29 | 15 | 100 | 39 | 266 | 144 | 535 | 360 | 694 | 487 |

Table 49. Ranges (in meters) to the onset of gastrointestinal injury impulse thresholds in the ECC and Lease Area for five UXO size classes assuming 10 dB of attenuation from use of a NAS. Thresholds are based on animal mass and submersion depth (see Section 6.2 and Hannay et al. 2022).

| **Hearing Group** | **$L_{pk}$ Threshold (dB re 1 µPa)** | **$R_{max}$ Distance (m)** E4 | E6 | E8 | E10 | E12 |
|---|---|---|---|---|---|---|
| Onset Gastrointestinal Injury | 237 | 21 | 34 | 58 | 99 | 125 |

Table 50. Ranges to Level A take SEL PTS-onset thresholds in the ECC for five UXO charge sizes assuming 10 dB of attenuation from use of a NAS and the maximum area exposed above the threshold.

| Hearing Group | SEL Threshold (dB re 1 $\mu Pa^2 \cdot s$) | $R_{95\%}$ Distance (km) E4 | E6 | E8 | E10 | E12 | Single Detonation Maximum Area ($km^2$) |
|---|---|---|---|---|---|---|---|
| Low-frequency | 183 | 0.72 | 1.46 | 2.86 | 4.16 | 4.84 | 73.6 |
| Mid-frequency | 185 | 0.056 | 0.107 | 0.239 | 0.469 | 0.597 | 1.1 |
| High-frequency | 155 | 2.46 | 3.47 | 4.84 | 6.54 | 7.39 | 171.6 |
| Phocid pinnipeds | 185 | 0.261 | 0.479 | 0.957 | 1.87 | 2.6 | 21.2 |

Table 51. Ranges to Level A take SEL PTS-onset thresholds in the Lease Area for five UXO charge sizes assuming 10 dB of attenuation from use of a NAS and the maximum area exposed above the threshold.

| Hearing Group | SEL Threshold (dB re 1 $\mu Pa^2 \cdot s$) | $R_{95\%}$ Distance (km) E4 | E6 | E8 | E10 | E12 | Single Detonation Maximum Area ($km^2$) |
|---|---|---|---|---|---|---|---|
| Low-frequency | 183 | 0.342 | 0.784 | 1.75 | 3.33 | 4.3 | 58.1 |
| Mid-frequency | 185 | <0.050 | <0.050 | 0.085 | 0.281 | 0.322 | 0.3 |
| High-frequency | 155 | 2.12 | 3.18 | 4.88 | 7.18 | 8.61 | 232.9 |
| Phocid pinnipeds | 185 | 0.072 | 0.156 | 0.506 | 1.15 | 1.56 | 7.6 |

In the case of UXO detonations, TTS onset serves as the Level B take threshold if only one detonation occurs per day. As was done for the Level A PTS threshold above, the largest modeled ranges to the TTS onset threshold assuming 10 dB of attenuation from use of a NAS for each UXO size class was selected from modeling results at Sites 3, 4, and 5 to represent the Level B range along the ECC (Table 52) and from Sites 1 and 2 for the Lease Area (Table 53).

Table 52. Ranges to Level B take SEL TTS-onset thresholds in the ECC for five UXO charge sizes assuming 10 dB of attenuation from use of a NAS and the maximum area exposed above the threshold.

| Hearing Group | SEL Threshold (dB re 1 $\mu Pa^2 \cdot s$) | $R_{95\%}$ Distance (km) E4 | E6 | E8 | E10 | E12 | Single Detonation Maximum Area ($km^2$) |
|---|---|---|---|---|---|---|---|
| Low-frequency | 183 | 2.74 | 4.45 | 7.21 | 10.3 | 11.8 | 437.4 |
| Mid-frequency | 185 | 0.41 | 0.707 | 1.23 | 2.03 | 2.48 | 19.3 |
| High-frequency | 155 | 6.14 | 7.84 | 10.1 | 12.6 | 13.7 | 589.6 |
| Phocid pinnipeds | 185 | 1.21 | 2.18 | 3.81 | 5.97 | 7.02 | 154.8 |

Table 53. Ranges to Level B take SEL TTS-onset thresholds in the Lease Area for five UXO charge sizes assuming 10 dB of attenuation from use of a NAS and the maximum area exposed above the threshold.

| Hearing Group | SEL Threshold (dB re 1 $\mu Pa^2 \cdot s$) | $R_{95\%}$ Distance (km) E4 | E6 | E8 | E10 | E12 | Single Detonation Maximum Area ($km^2$) |
|---|---|---|---|---|---|---|---|
| Low-frequency | 183 | 2.82 | 4.68 | 7.49 | 10.5 | 11.9 | 444.9 |
| Mid-frequency | 185 | 0.453 | 0.773 | 1.24 | 2.12 | 2.55 | 20.4 |
| High-frequency | 155 | 6.16 | 8 | 10.3 | 12.9 | 14.1 | 624.6 |
| Phocid pinnipeds | 185 | 1.47 | 2.35 | 3.82 | 5.98 | 6.99 | 153.5 |

Since the size and type of UXOs that may be detonated are currently unknown, all area calculations were made using the largest UXO size class (E12). The E12 ranges to Level A and Level B thresholds within the ECC, Table 50 and Table 52, respectively, were used as radii to calculate the area of a circle (pi × $r^2$ where r is the range to the threshold level) for each marine mammal hearing group. The results represent the largest area potentially ensonified above threshold levels from a single detonation within the ECC and are shown in the final column of Table 50 and Table 52. The same method was used to calculate the maximum area potentially ensonified above threshold levels from a single detonation in the Lease Area as shown in the final column of Table 51 and Table 53.

### *6.6.3 Exposure and Take Estimates from UXO Detonations*

Based on the available information, up to five (5) UXO detonations may be necessary within the ECC and up to five (5) UXO detonations within the Lease Area. The maximum areas to Level A and Level B thresholds from a single detonation in the ECC shown in Table 50 and Table 52, respectively, were therefore multiplied by 3 (for Year 1) and 2 (for Year 2) and then multiplied by the marine mammal densities shown in Table 42 to calculate the potential take from UXO detonations in the ECC shown in the ECC columns of Table 54. The division of 5 total detonations across the two years was based on the relative number of foundations to be installed in each year. In the Lease Area, the same method was applied using the maximum single detonation areas shown in Table 51 and Table 53 to calculate the potential take from UXO detonations in the Lease area shown in the LA columns of Table 54.

Monitoring and mitigation measures described in Section 11 are designed to prevent Level A take of most species. However, given the relatively large distances to the high-frequency cetacean SEL PTS threshold applicable to harbor porpoise and the difficulty with detecting this species, Level A take of 109 harbor porpoise is requested. Similarly, seals are difficult to detect at longer ranges and although the distances to the phocid hearing group SEL PTS threshold are not as large as those for high-frequency cetaceans, it may not be possible with the planned monitoring and mitigation measures to detect all seals within the threshold distances so Level A take of 40 gray seals and 4 harbor seals is requested. Although the UXO exposure modeling suggests potential Level A take for mysticete whales (Table 54), no Level A take is being requested for these species because it is assumed that monitoring and mitigation measures will prevent Level A take for these species.

Table 54. Level A and Level B exposure and take estimates from potential UXO detonations for construction years 1 and 2 assuming 10 dB of attenuation from use of a NAS. ECC = Export Cable Corridor, LA = Lease Area.

| | Density-based Exposure Estimates | | | | | | | | | | Take Estimates | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | | | | Year 2 | | | | PSO Data Based Estimate | Mean Group Size | Year 1 Level A Take | Year 1 Level B Take | Year 2 Level A Take | Year 2 Level B Take |
| | Level A | | Level B | | Level A | | Level B | | | | | | | |
| Species | ECC | LA | ECC | LA | ECC | LA | ECC | LA | | | | | | |
| ***Mysticetes*** | | | | | | | | | | | | | | |
| Blue Whale* | 0.002 | 0.002 | 0.015 | 0.015 | 0.001 | 0.001 | 0.010 | 0.010 | - | 1.0 | 1 | 1 | 1 | 1 |
| Fin Whale* | 0.284 | 0.819 | 6.167 | 6.272 | 0.190 | 0.546 | 4.111 | 4.181 | 0.5 | 1.8 | 2 | 13 | 1 | 9 |
| Humpback Whale | 0.275 | 0.605 | 4.554 | 4.632 | 0.183 | 0.403 | 3.036 | 3.088 | 4.6 | 2.0 | 1 | 10 | 1 | 7 |
| Minke Whale | 2.358 | 3.051 | 22.973 | 23.364 | 1.572 | 2.034 | 15.315 | 15.576 | 0.9 | 1.4 | 6 | 47 | 4 | 31 |
| North Atlantic Right Whale* | 0.491 | 0.648 | 4.878 | 4.961 | 0.327 | 0.432 | 3.252 | 3.307 | - | 2.4 | 2 | 10 | 1 | 7 |
| Sei Whale* | 0.163 | 0.338 | 2.542 | 2.586 | 0.109 | 0.225 | 1.695 | 1.724 | - | 1.6 | 1 | 6 | 1 | 4 |
| ***Odontocetes*** | | | | | | | | | | | | | | |
| Atlantic Spotted Dolphin | 0.001 | 0.007 | 0.392 | 0.415 | 0.000 | 0.004 | 0.262 | 0.276 | - | 29.0 | 1 | 29 | 1 | 29 |
| Atlantic White-Sided Dolphin | 0.034 | 0.037 | 2.204 | 2.330 | 0.023 | 0.025 | 1.470 | 1.554 | - | 27.9 | 1 | 28 | 1 | 28 |
| Bottlenose Dolphin | 0.014 | 0.020 | 1.161 | 1.228 | 0.010 | 0.013 | 0.774 | 0.819 | 11.9 | 12.3 | 1 | 13 | 1 | 13 |
| Common Dolphin | 0.112 | 0.326 | 19.323 | 20.430 | 0.075 | 0.217 | 12.882 | 13.620 | 103.6 | 34.9 | 1 | 104 | 1 | 104 |
| Harbor Porpoise | 14.604 | 50.302 | 127.356 | 134.902 | 9.736 | 33.535 | 84.904 | 89.935 | 0.0 | 2.7 | 65 | 263 | 44 | 175 |
| Pilot Whales | 0.001 | 0.003 | 0.171 | 0.180 | 0.000 | 0.002 | 0.114 | 0.120 | 0.5 | 10.3 | 1 | 11 | 1 | 11 |
| Risso's Dolphin | 0.001 | 0.003 | 0.204 | 0.215 | 0.001 | 0.002 | 0.136 | 0.144 | - | 5.4 | 1 | 6 | 1 | 6 |
| Sperm Whale* | 0.001 | 0.002 | 0.097 | 0.102 | 0.001 | 0.001 | 0.065 | 0.068 | 0.0 | 2.0 | 1 | 2 | 1 | 2 |
| ***Pinnipeds*** | | | | | | | | | | | | | | |
| Gray Seal | 20.420 | 3.487 | 70.614 | 70.012 | 13.613 | 2.325 | 47.076 | 46.675 | 0.3 | 1.4 | 24 | 141 | 16 | 94 |
| Harbor Seal | 1.326 | 0.226 | 4.585 | 4.546 | 0.884 | 0.151 | 3.057 | 3.031 | 4.3 | 1.4 | 2 | 10 | 2 | 7 |

* Denotes species listed under the Endangered Species Act.

### *6.6.4 Requested Take from Potential UXO Detonation*

The Level A take estimates incidental to potential UXO detonation are conservative in that they assume no mitigation measures other than 10 dB of sound attenuation. The additional mitigation measures described in Section 11, including clearance/shutdown zones, when implemented in practice will reduce the already very low probability of Level A take. However, Level A takes are requested for 109 harbor porpoise, 40 gray seals, and 4 harbor seals incidental to potential UXO detonations because these species are harder to detect than other species and distances to the PTS thresholds from the larger sized UXOs are large in comparison to their detectability. Table 55 shows the requested take incidental to UXO detonation that is included in the total take request in Section 6.7.

Table 55. Requested take from potential UXO detonation, included in the total take request in Section 6.7.

| Species | Year 1 |  | Year 2 |  | Total |  |
|---|---|---|---|---|---|---|
|  | Level A Take | Level B Take | Level A Take | Level B Take | Level A Take | Level B Take |
| ***Mysticetes*** |  |  |  |  |  |  |
| Blue Whale* | - | 1 | - | 1 | - | 2 |
| Fin Whale* | - | 13 | - | 9 | - | 22 |
| Humpback Whale | - | 10 | - | 7 | - | 17 |
| Minke Whale | - | 47 | - | 31 | - | 78 |
| North Atlantic Right Whale* | - | 10 | - | 7 | - | 17 |
| Sei Whale* | - | 6 | - | 4 | - | 10 |
| ***Odontocetes*** |  |  |  |  |  |  |
| Atlantic Spotted Dolphin | - | 29 | - | 29 | - | 58 |
| Atlantic White-Sided Dolphin | - | 28 | - | 28 | - | 56 |
| Bottlenose Dolphin | - | 13 | - | 13 | - | 26 |
| Common Dolphin | - | 104 | - | 104 | - | 208 |
| Harbor Porpoise | 65 | 263 | 44 | 175 | 109 | 438 |
| Pilot Whales | - | 11 | - | 11 | - | 22 |
| Risso's Dolphin | - | 6 | - | 6 | - | 12 |
| Sperm Whale* | - | 2 | - | 2 | - | 4 |
| ***Pinnipeds*** |  |  |  |  |  |  |
| Gray Seal | 24 | 141 | 16 | 94 | 40 | 235 |
| Harbor Seal | 2 | 10 | 2 | 7 | 4 | 17 |

* Denotes species listed under the Endangered Species Act.

## 6.7 Total Requested Take

The requested Level A and Level B take from all activities on a year-to-year basis is summarized in Table 56 and the total 5-year requested Level A and Level B take from all activities is summarized in Table 57. The request is based on estimated take as shown in Sections 6.3 to 6.6. Years 1 and 2 in Table 56 represent years in which WTG and OSP foundations would be installed, with Year 1 being the year involving foundation installation using only impact pile driving. Year 2 shows the maximum annual take requested over the period of the ITRs and includes installation of WTG and OSP foundations using a combination of vibratory and impact pile driving. The 5-year take request is not the sum of the five individual yearly requests. This is because, as noted in Section 6.3.4, the yearly take requests incidental to foundation installation are based on the maximum exposure estimates between the different scenarios for each Project, which was done to allow flexibility in Project installation and ensure sufficient take is requested for each year. The 5-year total take request is based on a realistic foundation installation scenario in which Project 1 Scenario 1 occurs (71 WTG monopiles and 1 OSP jacket) followed by Project 2 Scenario 2 (73 WTG monopiles and 1 OSP jacket) for a total of 146 foundations. Using the maximum number of foundations that could be installed in Year 2 ensures that Year 2 is the maximum yearly case. However, all five installation scenarios described in Section 6.3 are possible. In particular, Project 1 Scenario 2 plus Project 2 Scenario 3 (147 total foundations) remains a possibility. The 5-year take request uses the former, however, because it results in a greater number of estimated takes.

The Level B take shown in Table 56 for Year 1 and for Year 2 includes the maximum exposure estimates for each species from the two or three possible foundation installation scenarios shown in Section 6.3, except when mean group size or PSO daily sighting rate exceed the maximum modeled exposure estimate, in which case the largest of these values is used. Foundation installations may not occur in consecutive years or in the first year the ITRs are in place. Level B percent abundance was calculated for each individual year of Project activity by dividing the requested Level B take by the most recent abundance estimate in the 2022 NMFS Stock Assessment Report (Hayes et al. 2023) (Table 56). Percent abundance was calculated for the total 5-year requested Level B take as well and is shown in Table 57.

As described in Section 6.3.4, although monitoring and mitigation measures described in Section 11 are intended to prevent Level A take, the WTG and OSP foundation installation exposure ranges for fin whales were in some cases substantially larger than for other mysticete whales in years 1 and 2. Therefore, we selected the next largest exposure range distance to a mysticete whale as the pre-start clearance/shutdown zone. In most installation scenarios, 15-20% of the fin whale exposure range extends beyond the planned clearance/shutdown distance (exposure range for the second largest mysticete). Therefore, the requested take is 20% of the fin whale Level A exposure estimates produced by the exposure modeling. This results in 3 Level A takes for fin whales in Year 1 and 3 Level A takes in Year 2 (total of 6 across both years of foundation installation). Additionally, as described in Section 6.6.4, Level A takes are requested for 108 harbor porpoise, 13 gray seals, and 30 harbor seals from potential UXO detonations since these species are harder to detect than other species and distances to the PTS thresholds from the larger sized UXOs are large in comparison to their detectability.

Table 56. Summary of the requested Level A and Level B take from all activities on an annual basis for the Project.

| Species | NMFS Stock Abundance[a] | Year 1 | | | Year 2 (Maximum) | | | Year 3 | | | Year 4 | | | Year 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Level A Take | Level B Take | Level B % Abund. | Level A Take | Level B Take | Level B % Abund. | Level A Take | Level B Take | Level B % Abund. | Level A Take | Level B Take | Level B % Abund. | Level A Take | Level B Take | Level B % Abund. |
| ***Mysticetes*** | | | | | | | | | | | | | | | | |
| Blue Whale* | 402 | - | 3 | 0.7 | - | 3 | 0.7 | - | 1 | 0.2 | - | 1 | 0.2 | - | 1 | 0.2 |
| Fin Whale* | 6,802 | 3 | 58 | 0.9 | 3 | 496 | 7.3 | - | 4 | 0.1 | - | 4 | 0.1 | - | 4 | 0.1 |
| Humpback Whale | 1,396 | - | 99 | 7.1 | - | 341 | 24.4 | - | 35 | 2.5 | - | 35 | 2.5 | - | 35 | 2.5 |
| Minke Whale | 21,968 | - | 255 | 1.2 | - | 911 | 4.1 | - | 8 | 0.0 | - | 8 | 0.0 | - | 8 | 0.0 |
| North Atlantic Right Whale* | 338 | - | 26 | 7.7 | - | 111 | 32.8 | - | 5 | 1.5 | - | 5 | 1.5 | - | 5 | 1.5 |
| Sei Whale* | 6,292 | - | 15 | 0.2 | - | 48 | 0.8 | - | 2 | 0.0 | - | 2 | 0.0 | - | 2 | 0.0 |
| ***Odontocetes*** | | | | | | | | | | | | | | | | |
| Atlantic Spotted Dolphin | 39,921 | - | 87 | 0.2 | - | 378 | 0.9 | - | 29 | 0.1 | - | 29 | 0.1 | - | 29 | 0.1 |
| Atlantic White-Sided Dolphin | 93,233 | - | 784 | 0.8 | - | 3,101 | 3.3 | - | 28 | 0.0 | - | 28 | 0.0 | - | 28 | 0.0 |
| Bottlenose Dolphin | 62,851 | - | 451 | 0.7 | - | 2,489 | 4.0 | - | 89 | 0.1 | - | 89 | 0.1 | - | 89 | 0.1 |
| Common Dolphin | 172,974 | - | 9,823 | 5.7 | - | 42,363 | 24.5 | - | 778 | 0.4 | - | 778 | 0.4 | - | 778 | 0.4 |
| Harbor Porpoise | 95,543 | 65 | 691 | 0.7 | 44 | 2,609 | 2.7 | - | 69 | 0.1 | - | 69 | 0.1 | - | 69 | 0.1 |
| Pilot Whales | 39,215 | - | 83 | 0.2 | - | 657 | 1.7 | - | 11 | 0.0 | - | 11 | 0.0 | - | 11 | 0.0 |
| Risso's Dolphin | 35,215 | - | 49 | 0.1 | - | 1,772 | 5.0 | - | 6 | 0.0 | - | 6 | 0.0 | - | 6 | 0.0 |
| Sperm Whale* | 4,349 | - | 17 | 0.4 | - | 126 | 2.9 | - | 2 | 0.0 | - | 2 | 0.0 | - | 2 | 0.0 |
| ***Pinnipeds*** | | | | | | | | | | | | | | | | |
| Gray Seal | 27,300 | 24 | 542 | 2.0 | 16 | 8,606 | 31.5 | - | 234 | 0.9 | - | 234 | 0.9 | - | 234 | 0.9 |
| Harbor Seal | 61,336 | 2 | 94 | 0.2 | 2 | 488 | 0.8 | - | 33 | 0.1 | - | 33 | 0.1 | - | 33 | 0.1 |

* Denotes species listed under the Endangered Species Act

Table 57. Total 5-year requested Level A and Level B take from all activities for the Project.

| Species | NMFS Stock Abundance[a] | 5-Year Totals Level A Take | Level B Take | Percent of NMFS Stock Abundance[a] |
|---|---|---|---|---|
| ***Mysticetes*** | | | | |
| Blue Whale* | 402 | - | 9 | 2.2 |
| Fin Whale* | 6,802 | 6 | 566 | 8.4 |
| Humpback Whale | 1,396 | - | 541 | 38.8 |
| Minke Whale | 21,968 | - | 1,162 | 5.3 |
| North Atlantic Right Whale* | 338 | - | 149 | 44.1 |
| Sei Whale* | 6,292 | - | 67 | 1.1 |
| ***Odontocetes*** | | | | |
| Atlantic Spotted Dolphin | 39,921 | - | 552 | 1.4 |
| Atlantic White-Sided Dolphin | 93,233 | - | 3,762 | 4.0 |
| Bottlenose Dolphin | 62,851 | - | 3,171 | 5.0 |
| Common Dolphin | 172,974 | - | 52,943 | 30.6 |
| Harbor Porpoise | 95,543 | 109 | 3,442 | 3.7 |
| Pilot Whales | 68,139 | - | 773 | 1.1 |
| Risso's Dolphin | 35,215 | - | 1,839 | 5.2 |
| Sperm Whale* | 4,349 | - | 149 | 3.4 |
| ***Pinnipeds*** | | | | |
| Gray Seal | 27,300 | 40 | 9,835 | 36.2 |
| Harbor Seal | 61,336 | 4 | 677 | 1.1 |

* Denotes species listed under the Endangered Species Act

# 7 Anticipated Impact of the Activity

The ability to hear and transmit sound (echolocation and vocalization) 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 current 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 (SLs) and frequency (Richardson et al. 1995). The Project may impact marine mammals behaviorally and physiologically from temporary increases in underwater noise during construction, high resolution geophysical (HRG) surveys, or unexploded ordnance (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. 2007a). The level of impact on marine mammals will vary depending on the species and its sensitivity to sound, life stage, orientation and distance between the marine mammal and the activity, the intensity and duration of the activity, and environmental conditions affecting sound propagation.

## 7.1 Potential Effects of Project Activities on Marine Mammals

### *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. 2014b; Erbe et al. 2016; Tennessen and Parks 2016; Guan and Miner 2020). If little or no overlap occurs between the introduced sound and the frequencies used by the species, listening and communication are not expected to be disrupted. Similarly, if the introduced sound is present only infrequently, very little to no masking would occur. In addition to the frequency and duration of the masking sound, 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. 2013b; Branstetter et al. 2013a; 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. 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), as has vessel noise (Hatch et al. 2012; Putland et al. 2017; Cholewiak et al. 2018). 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). Other cetaceans are known to increase the source levels 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; Nieukirk et al. 2005; Scheifele et al. 2005; Parks et al. 2007; Di Iorio and Clark 2009; Hanser et al. 2009; Holst et al. 2009; Parks et al. 2009; 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.

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 impact pile driving. In this Project, however, impact pile driving is not expected to occur for more than approximately 4 hours at one time for monopile foundation installation and 2 hours per foundation for piled jacket installation. Compared to the 24 hour per day operation of airguns during most seismic surveys, the total time during which masking from impact pile driving might occur would be much lower.

The potential masking from vibratory pile driving (a continuous sound) is expected to be less than that for impulsive sounds from impact pile driving and airguns. 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), to 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 noise, such as from pile driving and vessel sounds. 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. Significant masking effects would be unlikely during impact pile driving (and also UXO explosions) given the intermittent nature of these sounds and short signal duration (Madsen et al. 2006). Similarly, even though it is a continuous sound, the potential for masking is deemed to be minimal during vibratory pile driving, as these sounds tend to have lower amplitudes resulting in smaller ranges. Some of the HRG survey equipment produces sounds within the frequency range of smaller cetaceans and pinnipeds and could therefore result in masking of some biologically important sounds. However, the impulsive nature of these sounds, source levels, short distances over which they would be audible, and continuous movement of the survey vessel suggest that any masking experienced by marine mammals would be localized and short term.

### *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 noise range from no response to mild aversion, to panic and flight (Southall et al. 2007b). Underwater explosions can also result in behavioral changes such as disturbance to regular migration and movement patterns, feeding, mating, calving/pupping, and resting (von Benda-Beckmann et al. 2015). 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. 2007a; Ellison et al. 2012; Ellison et al. 2018). Behavioral responses to noise in the marine environment can interfere with the motivation and attention of an animal (Branstetter et al. 2018), and can lead to decreased foraging efficiency or displacement from preferred feeding habitats, and 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. 2013a; 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. (2019) 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 Pile Driving*

Studies specific to behavioral responses of marine mammals to offshore wind developments have primarily been conducted on harbor porpoise (Tougaard et al. 2009b; Tougaard et al. 2009a; Bailey et al. 2010; Brandt et al. 2011; Dähne et al. 2013a; Thompson et al. 2013; Dähne et al. 2017) and harbor and gray seals (Edrén et al. 2010; Russell et al. 2016). Generally, these studies showed some avoidance during periods of construction activity, followed by 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 (Tougaard et al. 2009b; Brandt et al. 2011; Dähne et al. 2013a; Haelters et al. 2015; Dähne et al. 2017). Bailey et al. (2010) suggested that for harbor porpoise, behavioral disturbance from impact pile driving may occur up to 43.5 mi (70 km) away (based on a threshold of 90 $dB_{p\text{-}p}$ re 1 µPa), with major disturbance at distances up to 12.4 mi (20 km) (based on a threshold of 155 $dB_{p\text{-}p}$ re 1 µPa). Dähne et al. (2013a) 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 12.4 mi (20 km) from the activities, whereas static acoustic monitoring showed fewer detections within 6.7 mi (10.8) km from the sound source, and increased click rates between 15.5 and 31.1 mi (25 and 50 km) 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 7.5 mi [12 km]) as 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 to 4.5 hours (hrs) 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 6.2 – 9.3 mi (10–15 km) 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 as compared to periods before and after construction. There were fewer circling porpoises during pile driving and significantly more traveling within 9.3 mi (15 km) of the construction site (Tougaard et al. 2005). Based on Tougaard et al. (2005; 2009b; 2011) behavioral effects extended as far as 12.4 – 15.5 mi (20–25 km) 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; Teilmann 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 1.6 mi (2.6 km) from the construction site at Horns Rev II, with reduced acoustic activity for 24–72 h. Out to a distance of 2.9 mi (4.7 km), the recovery time was still longer than 16 hrs – the time between pile driving events; recovery time decreased with increasing distance from the construction site (Brandt et al. 2011). At a distance of ~13.7 mi (22 km), 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 (GBS)) 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 6.2 – 9.3 mi (10–15 km) from the wind farm (Tougaard et al. 2006a; Teilmann et al. 2008). Carstensen et al. (2006a) 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. 2006). 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. 2006, 2008).

Teilmann et al. (2006) 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, since the area is thought to be important to porpoises as a feeding ground; the Horns Rev area has much higher densities of animals compared to Nysted (Teilmann et al. 2006). Another explanation proposed by Teilmann et al. (2006) 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 compared to 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 compared with 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, as acoustic activity of harbor porpoises was greater during the 3 years of operation than the 2 years prior to construction. In addition, Leopold and

Camphuysen (2008) noted that construction of wind farm Egmond aan Zee did not lead to increased strandings in the area. Harbor porpoises near pile driving activities in Scotland may have exhibited a short-term response within 0.6 – 1.2 mi (1–2 km) of the installation site, but this was a short-term effect lasting 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 7.5 mi (12 km) 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 131 ft (40 m)-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).

A captive harbor porpoise exposed to vibratory pile driving sounds displayed an increase in respiration rates and jumps; however, this animal demonstrated rapid habituation to the sound (i.e., respiration rates decreasing towards baseline levels), after just 10 minutes (Kastelein et al. 2013). By the fourth and fifth replication, the harbor porpoise produced more clicks in response to the 140 dB re 1 μPa playback noise (Kastelein et al. 2013). An increase in click number suggests the harbor porpoises were compensating for the increased noise level. Auditory masking did not likely occur as the pile driving noise peak frequency was below 10 kHz and any energy above 60 kHz was below ambient levels (Kastelein et al. 2013).

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 study assessing the effects of vibratory pile driver noise on the 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 sound—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 suggests a shift of attention from the task to the noise source and/or a decrease in motivation to perform a 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 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 $L_{\mathrm{p,rms}}$ of 170 dB remained within 300 to 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 12.4 – 46.6 mi (20–75 km) 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 (206.7 ft [63 m]), received levels were 151 dB re 1 $\mu Pa_{rms}$ and 145 dB re 1 $\mu Pa^2 \cdot s$ $L_E$ (Blackwell et al. 2004). In contrast, harbor seals may be more response 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 8.7 mi (14 km) (based on a threshold of $L_{p,pk-pk}$ 160 dB re 1 μPa), and major disturbance within 820.2 ft (215 m) (based on a threshold of $L_{p,p-p}$ 200 dB re 1 μPa) of pile driving activities for harbor and grey seals. Russell et al. (2016) reported displacement of harbor seals during piling when received levels were between $L_{p,pk-pk}$ 166 and 178 re 1μPa. 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 2 hrs 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 15.5 mi (25 km) of pile driving activities or above single strike SELs of 145 dB re 1 $\mu Pa^2 s$. Teilmann et al. (2006) speculated that harbor porpoise may be more tolerant to disturbance at good foraging areas. Similarly, Hastie et al. (2021) found that captive grey 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 pretty 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, both aerial surveys and remote video monitoring did not show 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. (2006) 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 operation period (Teilmann et al. 2006). 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 HRG Surveys*

A number of studies have considered impacts from seismic airguns that produce a similar impulsive sound to impact pile driving. The effects of sounds from HRG surveys could include either masking of natural sounds or behavioral disturbance (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007a). Most types of HRG survey equipment produce impulsive sounds that could have similar effects on marine mammals as described previously for 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. This means that injurious takes are very unlikely.

Baleen whales generally tend to avoid impulsive sounds from operating airguns, but avoidance radii vary greatly (Richardson et al. 1995; Gordon et al. 2003). Whales are often reported to show no overt reactions to impulsive sounds 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. As noted earlier, some cetaceans are known to increase the source levels of their calls, shift their peak frequencies, or otherwise modify their vocal behavior (increase or decrease call rates) in response to pulsed sounds from airguns (Clark and Gagnon 2006; Castellote et al. 2012; Blackwell et al. 2013; Blackwell et al. 2015). Di Iorio and Clark (2010) found that blue whales in the St. Lawrence Estuary increased their call rates during operations by a lower-energy seismic source. The sparker used during the study emitted frequencies of 30–450 Hz with a relatively low source level of 193 $\text{dB}_{\text{pk-pk}}$ re 1 µPa.

Baleen whales exposed to strong 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 Gordon et al. (2003); Johnson et al. (2007); Ljungblad et al. (1988); Malme et al. (1984); Malme et al. (1985); Malme et al. (1988); McCauley et al. (1998); McCauley et al. (2000); Miller et al. (1999); Miller et al. (2005); Moulton and Holst (2010); Nowacek et al. (2007); Richardson et al. (1986); Richardson et al. (1995); Richardson et al. (1999; 2010); Richardson and Malme (1993); Stone (2015); Stone and Tasker (2006); and Weir (2008). 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 $\text{km}^2$ (546,806 $\text{mi}^2$) 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 (*Eschrichtius robustus*) 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 (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 1μPa$^2$s while migrating humpback whales demonstrated changes in migration at received levels of 144-151 dB re 1μPa$^2$s (McCauley 2003; Dunlop et al. 2017).

There is nearly no available information on marine mammal behavioral responses to multibeam echosounder sounds (MBES) (Southall et al. 2013). Much of the literature on marine mammal response to sonars relates to the types of sonars used in naval operations, including low-frequency, mid-frequency, and high-frequency active sonars (Southall et al. 2016). However, the MBES sounds are quite different from naval sonars. Ping duration of the MBES is very short relative to naval sonars. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; naval sonars often use near-horizontally-directed sound. In addition, naval sonars have higher duty cycles. These factors would all reduce the sound energy received from the MBES relative to that from naval sonars.

In September 2013, the operation of a MBES was linked to a mass stranding of melon-headed whales off Madagascar (Southall et al. 2013). During May–June 2008, ~100 melon-headed whales entered and stranded in the Loza Lagoon system in northwest Madagascar at the same time that a 12-kHz echosounder survey was being conducted ~65 km (40 mi) away off the coast. In conducting a retrospective review of available information on the event, an independent scientific review panel concluded that the Kongsberg EM 120 MBES was the most plausible behavioral trigger for the animals initially entering the lagoon system and eventually stranding. The independent scientific review panel, however, identified that an unequivocal conclusion on causality of the event was not possible because of the lack of information about the event and a number of potentially contributing factors. Additionally, the independent review panel report indicated that this incident was likely the result of a complicated confluence of environmental, social, and other factors that have a very low probability of occurring again in the future but recommended that the potential be considered in environmental planning. Leading scientific experts knowledgeable about MBESs expressed concerns about the independent scientific review panel analyses and findings (Bernstein 2013).

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. 2014b).

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 $\mathrm{SPL_{rms}}$ for non-impulsive sounds and 160 dB $\mathrm{SPL_{rms}}$ for impulsive 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*

The Project overlaps with biologically important feeding areas (BIAs) for fin, humpback, Minke, and Sei whales; however, the area impacted by the Project makes up a small portion of the BIAs. BIAs identify areas and times within which cetacean species or populations are known to concentrate for specific behaviors, or be range-limited, and provide additional context within which to examine potential interactions between cetaceans and human activities (NMFS 2022b). Short term avoidance in areas where sounds are above disturbance thresholds are expected to have little overall impact on these species. 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. 2013b).

## *7.1.3 Hearing Impairment*

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (Southall et al. 2007a; Finneran 2015). 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-impulse 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 watergun (Finneran et al. 2002), and to 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. (Southall et al. 2007b; Southall et al. 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; Nachtigall and Supin 2015; Nachtigall et al. 2016; Nachtigall et al. 2018; Finneran 2020; Kastelein et al. 2020).

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger 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. 2007a; 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; Tougaard et al. 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 $\mu Pa^2 s$, with exposure duration ranging from 15 minutes to 6 hours ($SEL_{cum}$ ranged from 173 to 187 dB re 1 $\mu Pa^2 s$). 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. 2019).

Unlike during studies with captive animals, during Project 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. 2013b; Stöber and Thomsen 2019).

Bailey et al. (2010) measured pile driving sounds during the construction of a wind farm in Scotland and predicting 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 $dB_{0\text{-}pk}$ re 1 μPa) and pinnipeds (218 $dB_{0\text{-}pk}$ 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.

Based on empirical measurements of pile driving sounds, there appears to be little risk for hearing impairment to marine mammals from vibratory pile driving, given the sound levels from vibratory pile driving are not expected to exceed 165 dB re 1 $\mu Pa_{rms}$ beyond 10 m (Illingworth and Rodkin 2007, 2017). Distances to injury thresholds for marine mammals are shorter for non-impulsive sounds when compared to impulsive sounds (Matthews et al. 2018). Thus, it is unlikely that marine mammals would be exposed to vibratory pile driving at a sufficiently high level for a sufficiently long period to cause more than mild

TTS. For non-impulsive sounds (such as vibratory pile driving), Southall et al. (2019) estimated that the received levels would have to exceed the TTS threshold by 20 dB, on an SEL basis, for there to be risk of PTS.

To experience any potential hearing impairment from HRG sources, marine mammals would have to occur in very close proximity to the survey equipment (Appendix B). This is because the relatively high frequency sounds produced by the survey equipment attenuate rapidly in water. With the implementation of planned monitoring and mitigation measures like pre-start watches and exclusion zones (Section 11), hearing impairment caused by HRG sources is extremely unlikely to occur. Most types of HRG survey equipment produce impulsive sounds that could have similar effects on marine mammals as described previously for 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. This means that injurious takes are very unlikely. Lurton (2016) modeled MBES radiation characteristics (pulse design, source level, and radiation directivity pattern) applied to a low-frequency (12-kHz), 240-dB source-level system. Using Southall et al. (Southall et al. 2007b) thresholds, he found that injury impacts were possible only at very short distances, e.g., at 5 m for maximum SPL and 12 m for cumulative SEL for cetaceans; corresponding distances for behavioral response were 9 m and 70 m. For pinnipeds, “all ranges are multiplied by a factor of 4” (Lurton 2016).

Although it is unlikely that pile driving activities and HRG surveys 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 strong enough to induce PTS. However, the rapid changes in pressure and short signal rise time involved in explosions may lead to PTS (Ketten 1995; von Benda-Beckmann et al. 2015). Marine mammals that communicate in the high-frequency range, such as harbor porpoise, are particularly sensitive to the effects of underwater explosions. Hearing damage and other physical injuries have been reported for cetaceans (Ketten et al. 1993; Ketten 1995) and pinnipeds (Fitch and Young 1948; Danil and St. Leger 2011).

The criteria used in the exposure modeling (Section 6.2) ([NMFS] National Marine Fisheries Service 2018) reflect the most recent scientific review and conclusions of NMFS regarding sound levels that could cause PTS. Based on the exposure modeling results, 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 the Project causing PTS in a marine mammal is considered unlikely.

### *7.1.4 Non-auditory Physical Effects*

Non-auditory physical effects may also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage (Cox et al. 2006; Southall et al. 2007b; Tal et al. 2015). Rolland et al. (2012) showed that ship noise causes increased stress in right whales. Wright et al. (2011), Atkinson et al.(2015), Houser et al. (2016), and Lyamin et al. (2016) also reported that sound could be a potential source of stress for marine mammals. Marine mammals close to underwater detonations of high explosives can be killed or severely injured (Koschinski 2011; Merchant et al. 2020), and the auditory organs are especially susceptible to injury (Ketten et al. 1993; Ketten 1995). Studies also indicate that smaller cetacean species are at greatest risk for shock wave or blast injuries (Ketten 2004). Hearing damage and other physical injuries have been reported for cetaceans (Ketten et al. 1993; Ketten 1995) and pinnipeds (Fitch and Young 1948; Danil and St. Leger 2011). Intense shock waves, because of their high peak pressures and rapid changes in pressure, can cause severe damage to animals. The most severe damage takes place at boundaries between tissues of different density. Different velocities are imparted to tissues of different densities, and this can physically disrupt the tissues. Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Yelverton et al. 1975; Hill 1978). Lung injuries can include laceration and rupture of the alveoli and blood vessels, which in turn can lead to hemorrhage, creation of air embolisms, and breathing difficulties. Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. The behavior of the pressure wave in the water column depends on water depth, sediment, sea state, stratification of the water column, temperature, salinity and other variables (Koschinski and Kock 2009; Salomons et al. 2021). Therefore, the specific effects on a given marine mammal will depend on all of these factors, as well as species, body size, the distance of the animal from the blast site, and the charge weight of the UXO in question (Hannay 2021).

Impacts associated with UXO detonation for the proposed Project are expected to be minimal for the following reasons: any required detonations will be timed to occur no more than once per day; the number of UXOs identified in the Project Area are expected to be low; and, the adoption of extensive mitigation measures (Section 11.4) will reduce or eliminate potential Level A harassment. Adverse effects are therefore not anticipated on marine mammal stocks or populations.

## 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 (Hayes et al. 2023). In most 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). Marine mammal abundance estimates are also available from Duke University Marine Geospatial Ecological Laboratory habitat-based models Roberts et al. (2016; 2023). Since the modeling included availability-bias corrections the abundance estimates can be larger than the SAR $N_{best}$ abundance estimates. However, the Roberts et al. (2016; 2023) models only provide estimates of abundance for the U.S. Atlantic EEZ which is a smaller area than occupied by the stocks defined by NMFS. By defining most stocks as inclusive of animals in the larger northwest Atlantic Ocean, including areas outside of the U.S. Atlantic EEZ, the SAR $N_{best}$ abundance estimates are larger for nearly all species. Thus, the SAR $N_{best}$ abundance estimates were used to calculate the percentage of each population or stock that could potentially receive Level A or Level B sound exposures during the Project construction activity (Table 56).

# 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. The SouthCoast Wind Project Area 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 the construction 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. Long-term impacts are those that might persist after construction is completed including during the operations phase of the SouthCoast Wind Project.

## 9.1 Short-Term Impacts

A variety of impact producing factors (i.e., seafloor disturbance, turbidity, physical presence of vessels and equipment, vessel discharges, and noise) with the potential to temporarily affect marine mammal habitat, including prey availability, may be expected as a result of the proposed activities. The marine mammal species found within the Project 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 Project vessels and equipment may cause some prey species to leave the immediate area of operations, 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. Noise generated by both impact and vibratory pile driving, as well as other Project activities, has the potential to elicit behavioral responses in fish, and impact pile driving and/or 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 positioned close to the noise source (Ruggerone et al. 2008). However, other studies have shown behavioral effects in response to impulsive pile driving sounds on 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 versus 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 which 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 et al. (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 have also shown behavioral responses to pile driving (Tidau and Briffa 2016). Disturbances associated with noise produced by construction activities are expected to be short-term and temporary with minor impacts to marine mammal prey species.

Seafloor disturbance is expected during seabed preparation, pile driving during foundation installation, placement of scour protection, offshore export cable/inter-array cable installation, construction vessel anchoring/installation vessel jack-up legs, and UXO detonation. The disturbance to the seabed from cable installation will include the trench footprint, the area surrounding the trench where sediment suspended during installation will settle, and the footprint of any cable protection. The Falmouth export cable (up to five cables) and the Brayton Point export cable (up to six cables) could result in a total seabed disturbance area of up to 709 hectares (ha) and 294 ha respectively. Inter-array cable installation could result in a total seabed disturbance area of up to 570 ha. Horizontal Directional Drilling (HDD) will be used to avoid seabed and ground surface disturbance in the nearshore and shoreline areas for the sea-to-shore transitions. Seabed disturbance from HDDs will be limited to the area where the HDD exists, within the nearshore area. The Falmouth (up to 4 HDDs) and Brayton Point/Aquidneck Island (up to 4 HDDs per landfall) locations could result in a total seabed disturbance area of up to 0.16 and 0.48 ha respectively.

All four substructure installation methods will require seabed preparation. For foundation installation, the seafloor will be disturbed within the footprint of the foundation and scour protection placed around the foundation, and in the immediate adjacent area during installation, depending on installation methodology and vessels used. The worst-case impacts were assessed with 147 WTGs and 2 OSPs (149 WTG/OSPs) to depict a scenario for the largest expected area of seabed disturbance. For OSP substructures, the maximum disturbance footprint area using pin-pile jackets is 7.8 ha. For WTG substructures, the maximum disturbance footprint area using pin-pile jackets, monopiles, or suction-bucket jackets is 183.75 ha, 179.34 ha, and 335.16 ha respectively. Vessel anchoring may cause a total seabed footprint area of up to 178.8 ha for 149 WTG/OSP. All seafloor disturbance and associated water turbidity is expected to be short-term and temporary with minimal effects on marine mammal habitat or prey items.

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. While the physical presence of vessels and deployed equipment may produce avoidance behavior, night lighting may serve to attract fishes and squid. Neither physical presence nor night lighting are expected to adversely affect prey species.

## 9.2 Long-Term Impacts

The presence of the Project's foundations (monopiles, piled jacket, or suction-bucket jacket), scour protection, and cable protection will result in a conversion of the existing sandy bottom habitat to a hard bottom habitat with areas of vertical structural relief (Wilhelmsson et al. 2006; Reubens et al. 2013; Bergström et al. 2014; Coates et al. 2014). Artificial structures can create increased habitat heterogeneity important for species diversity and density (Langhamer 2012). The WTG and OSP foundations will extend through the water column, which may serve to increase settlement of meroplankton or planktonic larvae on the structures in both the pelagic and benthic zones (Boehlert and Gill 2010). Fish and invertebrate species are also likely to aggregate around the foundations and scour protection which could provide increased prey availability and structural habitat (Boehlert and Gill 2010; Bonar et al. 2015).

Some scientists have recently raised concerns about the potential for the presence of offshore wind structures in this region to affect the availability of zooplankton prey to NARW. The concerns arise because in recent years NARW have appeared to increase their use of southern New England waters in and around Nantucket Shoals (Roberts et al. 2016; Quintana-Rizzo et al. 2021; Roberts 2022). Although right whales may be present in this area at any time of year (Davis et al. 2017b), their numbers are much higher in winter and early spring (Roberts et al. 2016; Roberts 2022). Analysis of photo-identification data from aerial surveys in 2017–2018 indicates that 15–20% of NARWs may occur in southern New England waters between December and May and that average individual residency time is 13 days (Quintana-Rizzo et al. 2021). Observations of NARW at that time of year have been described as consistent with foraging, but it is not known where in the water column or on what type of prey they may be foraging. It is further suggested that potential effects on oceanographic processes from the presence of offshore wind structures, both in the water and the air, could alter whatever food source may be present. Thus, in order for effects to occur, NARW present in this area would have to be foraging on prey that could be affected by changes to oceanographic processes and any changes to those processes would have to be large enough to alter the availability of NARW prey to a biological meaningful extent.

Seafloor disturbance is not quantified on its own for the operation and maintenance phase of the SouthCoast Wind Project as it is expected to be infrequent and minimal. Numerous studies have documented significantly higher fish concentrations including species like cod and pouting (*Trisopterus luscus*), flounder (*Platichthys flesus*), eelpout (*Zoarces viviparus*), and eel (*Anguila anguilla*) near the foundations than in surrounding soft bottom habitat (Langhamer and Wilhelmsson 2009; Bergström et al. 2013; Reubens et al. 2013). In the German Bight portion of the North Sea, fish were most densely congregated near the anchorages of jacket foundations, and the structures extending through the water column were thought to make it more likely that juvenile or larval fish encounter and settle on them (RI-CRMC 2010; Krone et al. 2013). In addition, at these structures fish can take advantage of the shelter provided while also being exposed to stronger currents created by the structures, which generate increased feeding opportunities and decreased potential for predation (Wilhelmsson et al. 2006). The presence of the foundations and resulting fish aggregations around the foundations is expected to be a long-term habitat impact, but the increase in prey availability could potentially be beneficial for marine mammals.

# 10 Anticipated Effects of Habitat Impacts on Marine Mammals

The loss or modification of marine mammal habitat could arise from alteration of benthic habitats, introduced noise, physical presence of vessels and equipment, and vessel discharges as described in the previous section. 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

Marine mammals use sound to navigate, communicate, find prey, and avoid predators. Acoustic "space" within their habitat must be available for species to conduct these activities. If noise levels within critical frequency bands preclude animals from accessing or utilizing the acoustic space of that habitat, then availability and quality of that habitat has been diminished. Thus, anthropogenic noise can be viewed as a form of habitat fragmentation resulting in a loss of acoustic space for marine mammals that could otherwise be occupied by vocalizations or other ecologically significant acoustic cues (Rice et al. 2014a). The sounds that marine mammals produce and hear will vary in terms of dominant frequency, bandwidth, energy, temporal pattern, and directionality. The same variables in ambient noise will, therefore, affect a marine mammal's acoustic resource availability. Acoustic propagation modeling conducted by JASCO (Appendix A) partially accounts for spectral characteristics of the sound received by animals through the application of NMFS marine mammal weighting functions, and it can be assumed animals within the behavior threshold isopleths may encounter a partial loss of acoustic space. Therefore, marine mammals may experience some short-term loss of acoustic habitat, but the nature and duration of this loss due to the temporary nature of the proposed activities is not expected to represent a significant loss of acoustic habitat.

Due to the small and short-term footprint of potential sediment disturbance caused by installation of the WTG and OSP foundations or the IAC and export cables combined with the availability of similar benthic habitat in and around the Project Area, it is expected that impacts to benthic habitats and associated prey from construction activities would have negligible effects on marine mammals (COP Appendix M).

Habitat impacts on marine mammals resulting from UXO detonation may take two forms: 1) the acoustic energy introduced into the water column from the blast itself, which could directly impact marine mammals as described in Section 7 and 2) the mortality or displacement of potential marine mammal prey in the immediate vicinity of the blast. Due to the short duration of any required detonation events, the relatively small number of potential UXOs identified in the Project Area, the comprehensive mitigation and monitoring measures proposed to exclude marine mammals from the immediate vicinity of the blast site, and the fact that marine mammals are highly mobile and able to leave the impacted area during these short-term detonation events, any habitat-related impacts to marine mammals are anticipated to be temporary and negligible.

## 10.2 Long-Term Impacts

The long-term habitat alteration due to the presence of WTG and OSP foundations and associated scour protection will provide hard-bottom habitat for potential marine mammal prey species and may increase the availability of prey species as discussed in Section 9.2. This could potentially alter marine mammal distribution and behavior patterns by increasing the number of marine mammals using this habitat for foraging. However, the effects of habitat alteration associated with the physical presence of the foundations and scour protection will not be universal across all marine mammal species since only some species are likely to use prey that become associated with those structures.

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, 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 (Hammar et al. 2010; Lindeboom et al. 2011; Mikkelsen et al. 2013; Russell et al. 2014; Arnould et al. 2015). 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; Vellejo 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). 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).

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). Navigation through or foraging within the Project Area is not expected to be impeded by the presence of the WTG and OSP foundations. Additionally, wakes in water currents created by the presence of the foundations are not expected to affect pelagic fish, plankton, or benthic species, so marine mammals foraging on these species are unlikely to be adversely affected. Given the likely benefits to some marine mammal species from increased prey abundance and the uncertain, but likely minimal negative impacts on large whales from the presence of the widely spaced foundations, overall impacts to marine mammal habitat are anticipated to be negligible.

# 11 Mitigation Measures

The monitoring and mitigation methods described below are intended to reduce or eliminate exposure of marine mammals to underwater sound levels that could constitute “take” under the MMPA. Many of the monitoring and mitigation methods are applicable across all Project activities while others will be specific to the following activities:

- WTG and OSP foundation installation using impact pile driving,
- WTG and OSP foundation installation using vibratory pile driving,
- High resolution geophysical (HRG) and remotely operated vehicle (ROV) surveys, and
- UXO detonation.

## 11.1 Standard Mitigation and Monitoring Requirements for all Project Activities

### *11.1.1 Protected Species Observer (PSO) and Acoustic Protected Species Observer (APSO) Experience and Responsibilities*

#### *11.1.1.1 Observer Qualifications and Training*

- All PSOs and APSOs will have met NMFS and BOEM training and experience requirements (including a NMFS-approved PSO training course).
- PSOs and APSOs will be employed by a third-party observer provider.
- Briefings between construction supervisors and crews and the PSO/APSO team will be held prior to the start of all Project activities as well as when new personnel join the vessel(s).
- The PSO team and the APSO team will each have a lead observer (Lead PSO and Lead APSO) who will be unconditionally approved by NMFS and have a minimum of 90 days at-sea experience in a northwestern Atlantic Ocean environment performing the visual (Lead PSO) or acoustic role (Lead APSO), with the conclusion of the most recent relevant experience no more than 18 months previous.
- APSOs responsible for determining if an acoustic detection originated from a NARW will be trained in identification of mysticete vocalizations.

#### 11.1.1.2 *Responsibilities and Authorities of PSOs and APSOs*

- PSOs will not have tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements.
- Lead PSOs carry the same duties as PSOs and also manage the activities associated with the PSO team, PAM team, and SFV team.
- Any PSO or APSO on duty will have authority to delay the start of operations or to call for a shutdown based on their observations or acoustic detections.
- Lead APSOs will be able to troubleshoot the acoustic equipment and assist in making final decisions regarding species identifications, localization, and other acoustic monitoring details that will be relayed to the Lead PSO.
- A clear line and method of communication between the PSOs and APSOs will be established and maintained to ensure mitigation measures are conveyed without delay.

### *11.1.2 Visual Monitoring*

- PSOs and APSOs will be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and will conduct a maximum of 12 hours of observation per 24-hour period.
- Each PSO and APSO will be provided with one 8-hour break per 24-hour period to sleep.
- Observations will be conducted (or electronic monitoring equipment installed) from the best safe vantage point(s) on the vessel or base of operations to ensure visibility of the shutdown zones.
- SouthCoast Wind is exploring opportunities to use currently available technologies to conduct monitoring using PSOs and APSOs who may be stationed in locations other than offshore vessels (e.g., onshore); however, this does not exempt onsite PSO requirements

described throughout section 11 (e.g., PSOs onboard the pile driving vessel, detonation vessel, or HRG survey vessel)
  - Onshore monitoring may include the use of imagery or data transmitted in real time (or near real time) from sensors located offshore. For example, EO, IR, or PAM sensors may be located on a variety of potential platforms.
- When conducting observations during Project activities, PSOs will scan systematically with the unaided eye, high-magnification (25 x 150 mm) binoculars, and/or standard handheld (7 x 50 mm) binoculars or other electronic methods to search continuously for marine mammals during all observational periods.
- When monitoring at night, or in low visibility conditions, PSOs will monitor for marine mammals and other protected species using night-vision devices with thermal clip-ons, a hand-held spotlight, and/or a mounted thermal camera system or other electronic methods.
- PSOs will watch for and record all marine mammal sightings regardless of the distance from the observer and/or sound source.
- Distances to observed animals will be estimated with range finders, reticle binoculars, clinometers when possible, or other electronic methods and based on the best estimate of the PSO when necessary.
- PSOs will record watch effort and environmental conditions on a routine basis.
- Members of the PSO and/or APSO team will consult with NMFS' NARW reporting system for the presence of NARWs in the Project Area.

### *11.1.3 Visual Monitoring During Vessel Transit*

- PSOs and/or trained vessel crew will observe for marine mammals at all times when vessels are transiting to/from and within the Project Area and port.
- PSOs and/or vessel crew will request vessel-strike avoidance measures if necessary (Section 11.1.5).

### *11.1.4 Acoustic Monitoring*

Acoustic monitoring and mitigation measures stated below will be followed during WTG and OSP foundation installation requiring pile driving only.

#### 11.1.4.1 Passive Acoustic Monitoring Methods

- APSOs will rotate on a 4-hour basis when monitoring from a 24-hour operation vessel or base of operations.
- A real-time PAM system will be used to supplement visual monitoring during all pre-start clearance, piling, and post-piling monitoring periods.
- Use of PAM will allow initiation of pile driving when visual observation of the entire pre-start clearance zone is not possible due to poor visibility, including darkness during nighttime operations.
- There will be one APSO on duty during both daytime and nighttime/low visibility monitoring.
- APSOs will immediately communicate all acoustic detections of marine mammals to PSOs performing visual observations including any determination regarding species identification, distance, and bearing of the marine mammal.

- The PAM system will not be located on the pile installation vessel to reduce masking of marine mammal sounds.
- A detailed description of the real-time PAM system will be developed and submitted to NMFS and BOEM for review and approval.

#### 11.1.4.2 *Sound Source Verification*

A detailed plan for Sound Source Verification (SSV) will be developed and submitted to NMFS prior to planned start of pile driving and UXO detonations.

- Pile Driving
    - Measurement of each pile type (monopiles and/or piled jackets) to be installed to determine the sound levels produced and effectiveness of the NAS(s).
    - Procedures for how measurement results will be used to justify any requested changes to planned monitoring and mitigation distances.
    - Measurements of received levels will be taken at 750 m and other various distances and azimuths relative to the pile location designed to gather data on sounds produced during installation scenarios specific to the Project (Figure 14). These measurements will be used to validate the modeled sound levels at 750 and other distances as provided in Appendix G1 of Appendix A to this application. These measurements are designed to assess whether or not the distances to the Level A and Level B harassment isopleths and/or other mitigation action distances align with the distances modelled.
        - SSV will include at least one recorder in each of the four azimuths around the pile (to capture potential directivity of the sound field). Additionally, there will be 3-4 recorders (one bottom and one mid-water column at each location) along one azimuth that is likely to see the lowest propagation loss to allow assessment of the modelled Level A and Level B isopleths.
- UXO Detonation
    - Measurements will be made for each UXO/MEC that must be detonated using the method described above for pile driving.

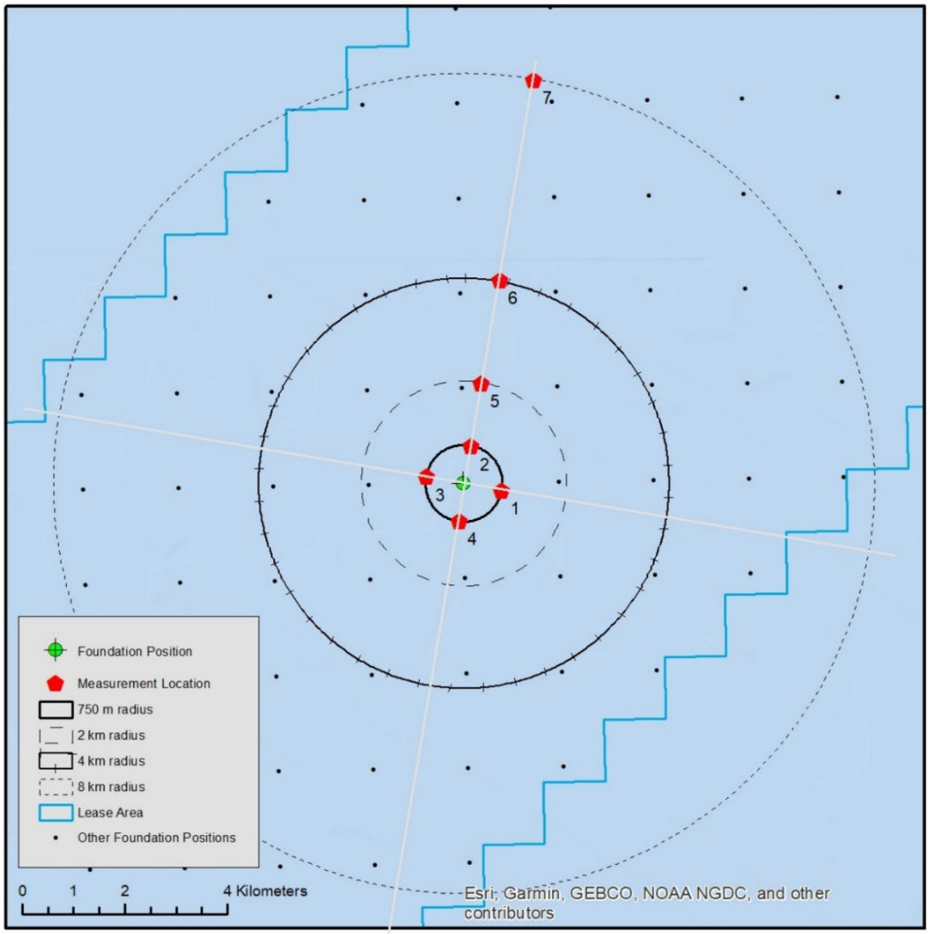

Figure 14. Conceptual design of sound source verification measurement locations relative to a foundation installation.

### *11.1.5 Vessel Strike Avoidance*

All vessels, including those transiting to and from local ports and the Project Area, will follow the vessel strike avoidance measures outlined below, except in cases where following these requirements would put the safety of the vessel or crew at risk.

#### *11.1.5.1 General Measures*

- Captain, first mate, and/or designated vessel personnel working offshore will receive training on marine mammal awareness and vessel strike avoidance measures.
- All vessels will have a minimum of one dedicated observer on watch (NMFS-approved PSO or trained crew member with no other concurrent duties) with standard equipment for daytime monitoring (handheld binoculars) and alternative equipment for low visibility conditions (night-vision devices and/or IR sensor). The dedicated observers will be trained in detection and identification of protected species, vessel strike minimization procedures and how and when to communicate with the vessel operator.
- Observers will maintain a vigilant watch for all marine mammals and slow down, change course, slow down or stop vessels to avoid striking protected species.

- PSOs, vessel captains or operators, and dedicated visual observers will continuously monitor all NMFS NARW reporting systems (Right Whale Sighting Advisory System [RWSAS], WhaleAlert, and VHF channel 16).

### *11.1.5.2 Separation Distances*

- Vessels will maintain, to the extent practicable, separation distances of:
    - >500 m distance from any sighted NARW or an unidentified large marine mammal,
    - >100 m from sperm whales and all other baleen whales,
    - >50 m from all other marine mammals, with the exception of animals approaching the vessel (e.g., delphinids and pinnipeds), in which case the vessel operator must avoid excessive speed or abrupt changes in direction.

### *11.1.5.3 Actions given observed marine mammal*

- If underway, all vessels will steer a course away from any sighted NARW at a distance greater than 500 m from the vessel and immediately leave the area at a slow safe speed (10 kts or less):
    - If a NARW comes within 500 m of an underway vessel, the vessel will reduce speed and shift the engines into neutral, if safe to do so;
    - The vessel will not engage engines until the NARW has moved outside of the vessel's path and beyond the 500 m minimum separation distance;
    - If the vessel is stationary, the vessel will not engage engines until the NARW has moved beyond 500 m;
    - If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator will assume that it is a NARW and take the appropriate mitigation measures as described above.
- If a vessel comes within 100 m of a non-NARW whale:
    - If underway, the vessel must attempt to remain parallel to the animal's course, reduce speed and shift the engine to neutral, if safe to do so, and must not engage the engines until the whale (e.g., large whale and/or ESA-listed whales besides NARW) has moved outside of the vessel's path and beyond 100 m.
    - If stationary, the vessel must not engage engines until the whale has moved beyond 100 m.
- All underway vessels will, to the maximum extent practicable, attempt to maintain a separation distance of 50 from all delphinid cetaceans and pinnipeds with the exception made for those that approach the vessel (e.g., bow riding dolphins).
    - Underway vessels will not divert to approach any small cetacean, seal, sea turtle, or giant manta ray;
    - If a delphinid cetacean that is not bow riding or a pinniped is sighted within 50 m of an underway vessel, that vessel will shift the engine to neutral. Engines will not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m.
- All sightings of dead or injured marine mammals or sea turtles will be reported within 24 hours (Section 11.1.7).

#### *11.1.5.4 Speed Reduction*

- Vessels will comply with current mandatory measures stipulated in the NOAA NARW Vessel Strike Reduction Regulations;
- All vessels, regardless of size, will transit at 10 knots or less within any active NARW SMA and Slow Zone (i.e., DMA or acoustically-triggered Slow Zones)
- During migratory and calving periods from **November 1 to April 30**, all project vessels will operate at 10 knots or less when in the Project Area;
- All vessel speeds will be reduced to ≤10 kts when mother/calf pairs, pods, or large assemblages of marine mammals are observed;
- SouthCoast Wind will implement (or participate in a joint program, if developed) a PAM system designed to detect NARW within the transit corridor and additional visual monitoring measures as described below. A Vessel Strike Avoidance Plan that provides a more detailed description of the equipment and methods to conduct the monitoring summarized here will be provided to NMFS at least 90-days prior to commencement of vessel movements associated with the activities covered by the requested incidental take regulations.
  - Acoustic Monitoring
    - A PAM system consisting of near real-time bottom mounted and/or mobile acoustic monitoring systems will be installed such that NARW and other large whale calls made in or near the corridor can be detected and transmitted to the transiting vessel (either directly or through an operations base).
    - The detections will be used to determine areas along the transit corridor where vessels would be allowed to travel at >10 kts when no other speed restrictions are in place (e.g., 10 knot speed restriction in SMAs and DMAs);
    - Any detection of a large whale (including NARW) via the PAM system within the transit corridor will trigger a 10 knot or less speed restriction for all Project vessels until the whale can be confirmed visually beyond 500 m of the vessel or 24 hours following the detection and any re-detection has passed.
  - If the PAM system temporarily stops working the following procedures will be followed.
    - All vessels, regardless of size, will transit at <10 kts in all SMAs (applicable November 1st to April 30th) and DMAs (at any time of year).
    - Between May 1 and October 31, all vessels, regardless of size, will transit at >10 kts and implement the visual monitoring measures with a dedicated observers as described above.

### *11.1.6 Data Recording*

- All data will be recorded based on standard PSO collection requirements using industry-standard software.
- Data recorded will include information related to ongoing operations, observation methods and effort, visibility conditions, marine mammal detections, and any mitigation actions requested and enacted.

### *11.1.7 Reporting*

The following situations would require reporting as defined below:

- If a stranded, entangled, injured, or dead protected species is observed, the sighting will be reported immediately and within 24 hours to NMFS Sighting Advisory System (SAS) hotline.
- Any NARW sightings will be reported as soon as feasible and no later than within 24 hours to the NMFS Right Whale Sighting Advisory System (RWSAS) hotline (866-755-6622) or via the Whale Alert Application.
- If a marine mammal is taken in a prohibited manner by Project activities, the following actions will occur:
    - Activity operations resulting in the injury/death will cease immediately.
    - The incident will be reported to the NMFS OPR (301-427-8401), NMFS New England Stranding Network Coordinator, and the Greater Atlantic Regional Fisheries Office (GARFO) no later than within 24 hours.
    - Additional reporting by the vessel captain or PSO onboard will be to NMFS Fisheries Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-775-6622), or alternative electronic reporting systems as approved by the NMFS stranding program, as well as the U.S. Coast Guard (USCG).
    - The report will include all available information required by the ITR or the NMFS stranding report form.
    - SouthCoast Wind will not resume the activity which resulted in the injury until NMFS OPR is able to review the circumstances of the incident determine the appropriate course of action.
- Actions given an unknown and recent observed dead or injured marine mammal:
    - SouthCoast Wind will immediately report the incident to the NMFS OPR and the NMFS New England Stranding Network Coordinator (as stated above).
    - The report will include the same information identified for a take by construction activity.
    - Activities will continue while NMFS reviews the circumstances of the incident and works with SouthCoast Wind to determine whether modifications to the activities are appropriate.
- Actions given observation of a dead or injured marine mammal not associated with or related to construction activities:
    - SouthCoast Wind will report the incident to the NMFS OPR and the NMFS New England Stranding Network Coordinator, within 24 hours of the discovery.
    - SouthCoast Wind will include any documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network including photographs and video footage if available.
    - Construction activities may continue.

#### *11.1.7.1 Data and Final Reports will be prepared using the following protocols:*

- All vessels will utilize a standardized data entry format.
- A quality assurance/ quality control (QA/QC'd) database of all sightings and associated details (e.g., distance from vessel, behavior, species, group size/composition) within and

outside of the designated shutdown zone, monitoring effort, environmental conditions, and Project-related activity will be provided after field operations and reporting are complete.

- During all pile driving activities, weekly reporting summarizing sightings, detections, and activities will be provided to NMFS and BOEM on the Wednesday following a Sunday-Saturday period.
- Monthly reports will be required during all pile driving activities including 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 actions taken.
- Monthly reports will be submitted to NMFS on the 15th of the month for the previous month.
- Final reports will follow a standardized format for PSO reporting from activities requiring marine mammal mitigation and monitoring.
- An annual report summarizing the prior year's activities will be provided to NMFS and BOEM 90-days after completion of each 12-month period during the effectiveness of the ITRs.

## 11.2 WTG and OSP Foundation Installation

Monitoring and mitigation protocols applicable to impact and vibratory pile driving during SouthCoast Wind construction are described further in the following subsections. Impact and vibratory pile driving may be initiated after dark or during daytime reduced visibility periods following the protocols in Section 11.2.3 and Section 11.2.4.

### *11.2.1 Monitoring Equipment*

The following types of equipment will be used to monitor for marine mammals from one or more locations.

- Reticle binoculars
- Mounted thermal/IR camera system
    - The camera systems may be automated with detection alerts that will be checked by a PSO on duty; however, cameras may not be manned by a dedicated observer.
- Mounted "big-eye" binocular
- Monitoring station for real time PAM system (impact pile driving only)
- The selected PAM system will transmit real time data to PAM monitoring stations on the vessels and/or shore side monitoring station.
- Hand-held or wearable NVDs
- IR spotlights
- Data collection software system
- PSO-dedicated VHF radios
- Digital single-lens reflex camera equipped with 300-mm lens

### *11.2.2 Daytime Visual Monitoring*

Visual monitoring will occur from the construction vessel and two dedicated PSO vessels. Daytime visual monitoring is defined by the period between nautical twilight rise and set for the region. Visual monitoring measures below intend to provide complete visual coverage of the pre-start clearance zone during the pre-start clearance period prior to pile driving and the shutdown zones during impact and vibratory pile driving. The following visual monitoring protocols include:

- Three on duty PSOs will keep watch from each platform (the pile driving vessel and two PSO vessels) during the pre-start clearance period, throughout pile driving, and 30 minutes after piling is completed.
- At least three PSOs on duty on each platform during all other daylight periods.
- PSOs will monitor for at least 60 minutes before, during, and 30 minutes after each piling event.
- One PSO will monitor areas closer to the pile being stalled for smaller marine mammals using the naked eye, reticle binoculars and/or other electronic method(s) while two PSOs scan farther from the pile using the mounted big eye binoculars and/or other electronic method(s).
- PSO will monitor the NMFS NARW reporting systems including WhaleAlert and SAS once every 4-hour shift during Project related activities.

### *11.2.3 Daytime Periods of Reduced Visibility*

These measures will apply during the pre-start clearance period, during active pile driving, and 30 minutes after piling is completed.

- If the Level B harassment zone is obscured, the three PSOs on watch will continue to monitor the shutdown zone utilizing thermal camera systems and/or other electronic method(s) and PAM.
- During nighttime or low visibility conditions, the three PSOs on watch will monitor the shutdown zone with the mounted IR camera (further described in 11.2.4), available handheld night vision, and/or other electronic method(s).
- All on-duty PSOs will be in contact with the APSOs who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area (impact pile driving only).

### *11.2.4 Nighttime Visual Monitoring*

During nighttime operations, night vision equipment (night vision goggles) and infrared/thermal imaging technology will be used. Recent studies have concluded that the use of infrared/thermal imaging technology allow for the detection of marine mammals at night (Verfuss et al. 2018). Guazzo et al (2019) showed that probability of detecting a large whale blow by a commercially available infrared camera was similar at night as during the day; camera monitoring distance was 2.1 km (1.3 mi) from an elevated vantage point at night versus 3 km (1.9 mi) for daylight visual monitoring from the same location. The following nighttime piling monitoring and mitigation methods use the best currently available technology to mitigate potential impacts and result in the least practicable adverse impact.

- During nighttime operations, visual PSOs on-watch will work in three person teams observing with an NVDs and/or monitoring IR thermal imaging camera systems. There will also be an APSO on duty conducting acoustic monitoring in coordination with the visual PSOs.

- The PSOs on duty will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons, a hand-held spotlight (one set plus a backup set) and/or other electronic method(s), such that PSOs can focus observations in any direction.
- If possible, deck lights will be extinguished or dimmed during night observations when using the NVDs (strong lights compromise the NVD detection abilities); alternatively, if the deck lights must remain on for safety reasons, the PSO will attempt to use the NVDs in areas away from potential interference by these lights.

SouthCoast will prepare a more detailed description of the anticipated efficacy of the technologies it intends to use during nighttime monitoring and describe how they will be used to monitor the pre-start clearance and shutdown zones. This will be provided to NMFS after publication of the draft ITRs so that it can be considered during preparation of the Final ITRs.

### *11.2.5 Acoustic Monitoring*

Since visual observations within the applicable shutdown zones can become impaired at night or during daylight hours due to fog, rain, or high sea states, visual monitoring with thermal and NVDs will be supplemented by PAM during these periods. An APSO will be on watch during all pre-start clearance, piling, and post-piling monitoring periods (daylight, reduced visibility, and nighttime monitoring). A combination of alternative monitoring measures, including PAM, has been demonstrated to have comparable detection rates (although limited to vocalizing individuals) to daytime visual detections for several species (Smith et al., 2020).

- There will be one APSO on duty who will begin monitoring at least 60 minutes prior to initiation of pile driving, continue throughout piling, and extend at least 30 minutes post installation during both daytime and nighttime/low visibility conditions; All on-duty PSOs will be in contact with the APSO on duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.
- For real-time PAM systems, at least one APSO will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore.
- The PAM operator will inform the PSOs on duty of animal detections approaching or within the applicable mitigation zones via the data collection software system (i.e., Mystcetus or similar system) or other direct forms of communication (radio, phone, messaging app). The PSO will then be responsible for requesting that any necessary mitigation procedures are implemented.
- The PAM system will have the capability of monitoring up to 10 km from the pile.
- A PAM Plan will be submitted to NMFS and BOEM prior to the planned start of pile driving.

### *11.2.6 Pre-Start Clearance*

A pre-start clearance period will be implemented for all foundation installation occurring both inside and outside the 20-km area of concern (as described in Section 1). For foundations installed within the 20-km area of concern (June 1 through October 15), a minimum visibility zone[1] of 4,900 m for pin pile and 7,500 m for monopile installation will be implemented. For OSP foundations (and WTG jacket foundations, if installed) installed throughout the rest of the Lease Area (outside the area of concern), a minimum visibility zone[2] of 2,600 m for pin pile and 3,700 m for monopile and pin pile installation will be implemented. For impact pile driving, PAM will begin 60 minutes prior to the start of pile driving. Pre-start clearance zones will follow the same zone sizes as presented below in Section 11.2.9.

- Visual monitoring will begin at least 60 minutes prior to the start of impact pile driving and 30 minutes prior to the start of vibratory pile driving;
- To begin the clearance process, PSOs will visually clear (i.e., confirm no observation of marine mammals) the relevant minimum visibility zone for 30 minutes immediately prior to commencing foundation installation activities.
  - If PSOs cannot visually monitor the relevant minimum visibility zone prior to the start of pile driving, pile driving operations will not commence.
- Once the clearance process has begun, visual monitoring will be conducted (including the use of IR and NVD systems, as appropriate) and PAM for at least 60 minutes prior to the start of soft-start;
- If a marine mammal is observed entering or within the relevant clearance zone, pile driving activity will be delayed.
- An acoustic detection localized to a position within the relevant clearance zone(s) will trigger a delay.
- Impact and/or vibratory pile driving may commence when either the marine mammal(s) has voluntarily left the specific clearance zone and been visually or acoustically confirmed beyond that clearance zone, or, when the additional time period has elapsed with no further sighting or acoustic detection (i.e., 15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes for sperm and baleen whales [including NARWs]).
  - In cases where these criteria cannot be met, pile driving may restart only if necessary to maintain pile stability at which time SouthCoast Wind will use the lowest hammer energy practicable to maintain stability.

### *11.2.7 Soft Start*

- Soft start procedures will be followed, to the extent practicable, at the beginning of each pile driving event or any time pile driving has stopped for longer than 30 minutes.
- A soft start procedure will not begin until the relevant clearance zone has been cleared by the visual PSO or APSOs.
- If a marine mammal is detected within or about to enter the relevant clearance zone, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been

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[1] The minimum visibility zone sizes implemented during foundation installation of pin piles and monopiles within the 20-km area of concern are set equal to the largest Level B harassment zone (unweighted acoustic ranges to 160 dB re 1 µPa sound pressure level in summer) modeled at for each substructure type assuming 10 dB of noise attenuation.

[2] The minimum visibility zone sizes implemented during foundation installation of pin piles and monopiles occurring throughout the rest of the Lease Area (outside the area of concern) are set equal to the second largest low-frequency Level A $SEL_{cum}$ exposure ranges ($ER_{95\%}$) with 10 dB of noise attenuation for foundation installation across Year 1 and Year 2.

observed exiting the relevant clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm and baleen whales [including NARWs]).

### *11.2.8 Shutdowns*

- If conditions change such that PSOs cannot monitor the relevant shutdown zone following the commencement of pile driving, the PSO will request an immediate shutdown.
- If a marine mammal is detected entering or within the respective shutdown zone after pile driving has commenced, an immediate shutdown of pile driving will be requested unless the Chief Engineer or Vessel Captain determine shutdown is not feasible.
- If a shutdown is not feasible at that time in the installation process due to a 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 risk of jeopardizing the installation process (pile refusal or instability), a reduction in the hammer energy of the greatest extent possible will be implemented.
- The shutdown zone will be continually monitored by PSOs and APSOs during any pauses in pile driving.
- If a marine mammal is sighted within the shutdown zone during a pause in piling, resumption of pile driving will be delayed until the animal(s) has exited the relevant shutdown zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm and baleen whales [including NARWs]).
- Following shutdown, pile driving will restart using the same procedure described above in Section 11.2.7.

### *11.2.9 Shutdown Zones*

The shutdown zones below (Section 11.2.9.1 through 11.2.9.6) are based upon the Level A exposure ranges with 10 dB of noise attenuation for foundation installation across Year 1 and Year 2 (further details in Section 6.3). If the shutdown zone is equivalent to the “NAS perimeter”, this means the outside perimeter of the NAS. Therefore, any animals occurring within the NAS would trigger a shutdown. The NARW shutdown zones (Section 11.2.9.1 through 11.2.9.6) are based on the requirement that a visual or acoustic observation of a NARW at any distance will result in immediate shutdown measures described in Section 11.2.8. Foundation installations include 9/16 m (tapered) diameter WTG monopiles and 4.5 m WTG and OSP jacket pin piles installed using impact pile driving only during Year 1. During Year 2, foundations may be installed using only impact pile driving or may use a combination of vibratory and impact pile driving. The shutdown zones are the largest zone sizes expected to result from foundation installations for each installation schedule, except in cases where a single species (e.g. fin whales) had a much larger modeled exposure range than other large cetaceans and the next largest zone size was selected. If smaller diameter piles, lower maximum hammer energies and/or total strikes per pile, or more effective NAS are decided upon and used during the construction activities, modeled Level A exposure ranges applicable to those revised parameters would be used, likely resulting in shorter shutdown zone distances than those shown below based on current maximum pile size and hammer energy assumptions.

### 11.2.9.1 WTG Monopile and WTG Jacket Installations Using Only Impact Driving in Summer

WTG Monopile Impact Driving

- Low-Frequency Cetaceans: 3,500 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 200 m

WTG Jacket Impact Driving

- Low-Frequency Cetaceans: 2,000 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: NAS perimeter

### 11.2.9.2 WTG Monopile and WTG Jacket Installations Using Only Impact Driving in Winter

WTG Monopile Impact Driving

- Low-Frequency Cetaceans: 3,700 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 200 m

WTG Jacket Impact Driving

- Low-Frequency Cetaceans: 2,300 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 400 m

### 11.2.9.3 WTG Monopile and Jacket Foundations using Combined Vibratory and Impact Driving (Year 2 only) in Summer

WTG Monopile during Impact driving

- Low-Frequency Cetaceans: 3,500 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 200 m

WTG Monopile during Vibratory driving

- Low-Frequency Cetaceans: 200 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: NAS perimeter

WTG Jacket during Impact driving

- Low-Frequency Cetaceans: 1,900 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: NAS perimeter

WTG Jacket during Vibratory driving

- Low-Frequency Cetaceans: NAS perimeter
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: NAS perimeter

#### *11.2.9.4 Concurrent Installation of One WTG Monopile and Four OSP Jacket Pin Piles in Summer*

WTG Monopile during Impact driving

- Low-Frequency Cetaceans: 3,500 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 300 m

#### *11.2.9.5 Concurrent Installation of Four WTG Jacket Pin Piles and Four OSP Jacket Pin Piles in Summer*

WTG Jacket during Impact driving

- Low-Frequency Cetaceans: 2,600 m
- NARW: At any distance
- Mid-Frequency Cetaceans: NAS perimeter
- High-Frequency Cetaceans: NAS perimeter
- Seals: 200 m

### *11.2.10Post-Piling Monitoring*

- PSOs will continue to survey the shutdown zone throughout the duration of pile installation and for a minimum of 30 minutes after piling has been completed.

### *11.2.11 Noise Attenuation*

Several recent studies summarizing the effectiveness of noise attenuation systems (NAS) have shown that broadband sound levels are likely to be reduced by anywhere from 7 to 17 dB, depending on the environment, pile size, and the size, configuration and number of systems used . The single bubble curtain applied in shallow water environments regularly achieves 7-8 dB broadband attenuation (Lucke et al. 2011; Rustemeier et al. 2012; Bellmann 2014; Bellman 2019). More recent in situ measurements during installation of large monopiles (~8 m) for WTGs in comparable water depths and conditions indicate that attenuation levels of 10 dB are readily achieved for a single bubble curtain (Bellman 2019; Bellmann et al. 2020). Large bubble curtains tend to perform better and more reliably, particularly when deployed with two rings (Koschinski and Ludemann 2013; Bellmann 2014; Nehls et al. 2016). A California Department of Transportation study tested several small, single, bubble curtain systems and found that the best attenuation systems resulted in 10-15 dB of attenuation (Buehler et al. 2015). Buehler et al. (2015) concluded that attenuation greater than 10 dB could not be reliably predicted from small, single, bubble curtains because sound transmitted through the seabed and re-radiated into the water column is the dominant sound in the water for bubble curtains deployed immediately around the pile. Combinations of systems (e.g., double big bubble curtain, hydrodsound damper plus single big bubble curtain) potentially achieve much higher attenuation. The type and number of NAS to be used during construction have not yet been determined. Based on prior measurements this combination of NAS are reasonably expected to achieve far greater than 10 dB broadband attenuation of impact pile driving sounds. SouthCoast Wind will operate NAS to meet noise levels modeled (10 dB attenuation) and will not exceed these levels. However, if SSV suggests noise levels are louder than modeled, additional noise attenuation measures will be implemented to further reduce noise levels to at least those modeled.

### *11.2.12 Sound Source Verification*

- SSV measures will be followed as stated in Section 11.1.4.2.

### *11.2.13 Potential Additional Measures to Protect North Atlantic Right Whales*

To complete installation within as few years as possible during the multiple year installation campaign expected for the entire Lease Area build-out, impact pile driving 24-hours per day is deemed necessary.

- The period from January through April is when the highest number of NARW are present in the region which means foundation installations during this period would likely result in greater potential impacts to this species. To reduce the need for foundation installations during this period and associated impacts to the NARW, SouthCoast Wind may conduct nighttime pile driving of monopile or piled jacket foundations during time periods when the fewest number of NARW are likely to be present in the region. Specific measures will include:
    - Concentrating pile driving activities when NARW are less likely to be present within the region (May 15 through December 31), including in the Lease Area.
    - Specific monitoring tools and plans will be developed as a part of the ongoing ITR Application process, but may include the use of advanced infrared systems, near real-time PAM, autonomous underwater vehicles, autonomous aerial vehicles, or other advanced technologies that could improve the probability of detecting marine mammals at night.

As a result of concerns related to potential NARW use of the Nantucket Shoals region outside of the January–April period, additional mitigation and monitoring measures have been proposed in a NARW mitigation and monitoring plan for pile driving. These measures include the commitment to only use impact pile driving in specified areas of the Lease Area (Project 1) and to monitor and mitigate for NARW within the Level B disturbance zones for impact pile driving. These measures also include a commitment that no pile driving for foundation installations will occur from January 1 through May 14 each year. On top of the seasonal description described, no pile driving for WTG or OSP foundation installations will occur within the 20-km area of concern during the month of May or after October 15.

Please refer to the *Supplemental North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving* submitted separately for additional details.

## 11.3 HRG Surveys

HRG survey activities may be required during construction and the operations and maintenance (O&M) phases of the Project. When necessary, HRG survey operations will be conducted 24-hours per day, although some vessels may only operate during daylight hours. The following mitigation and monitoring measures for HRG surveys apply only to sound sources with operating frequencies below 180 kHz. There are no mitigation or monitoring protocols required for sources operating >180 kHz.

Additionally, shutdown, pre-start clearance, and ramp-up procedures will not be conducted during HRG operations using only non-impulsive sources (e.g., USBL and parametric sub-bottom profilers) other than non-parametric sub-bottom profilers (e.g., CHIRPs). Pre-start clearance and ramp-up, but not shutdown will be conducted when using non-impulsive, non-parametric sub-bottom profilers.

### *11.3.1 Monitoring Equipment*

- Two pairs of reticle binoculars;
- Two hand-held or wearable night vision devices (NVDs);
- Two IR spotlights;
- One data collection software system;
- Two PSO-dedicated very high frequency (VHF) radios;
- One digital single-lens reflex camera equipped with a 300-mm lens.

### *11.3.2 Visual Monitoring*

- Four PSOs on board any 24-hour survey vessels.
- Two PSOs on board any daylight survey vessels.
- One PSO on watch during all daylight surveying.
- Two PSOs on watch during nighttime surveying.
- Vessels conducting activities in very-shallow waters:
    - One visual PSO will be onboard
    - The vessel captain (or crew member on watch) will conduct observations when the PSO is on required breaks;
    - The PSO on duty will remain available to confirm sightings and any related mitigation measures while on break.
- PSOs will begin observation of the shutdown zones prior to initiation of HRG survey operations and will continue throughout the survey activity and/or while equipment operation below 180 kHz is in use.
- PSO will monitor the NMFS NARW reporting systems including WhaleAlert and SAS once every 4-hour shift during Project related activities.

### *11.3.3 Daytime Visual Monitoring*

The following protocols will be applied to visual monitoring during daytime surveys:

- One PSO on watch during pre-start clearance periods and all source operations.

- PSOs will use reticle binoculars and the naked eye to scan the shutdown zone for marine mammals.

### 11.3.4 Nighttime and Low Visibility Monitoring

Visual monitoring during nighttime surveys or periods of low visibility will utilize the following protocols:

- The Lead PSO will determine if conditions warrant implementing reduced visibility protocols.
- Two PSOs on watch during pre-start clearance periods, all operations, and for 30 minutes following use of HRG sources operating below 180 kHz.
- Each PSO will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons and a hand-held spotlight (one set plus a back-up set), such that PSOs can focus observations in any direction.

### 11.3.5 Shutdown Zones

PSOs will establish and monitor marine mammal shutdown zones. Distances to shutdown zones will be from any acoustic sources, not the distance from the vessel. Shutdown zones will be as follows:

- 500 m from NARW for use of impulsive acoustic sources (e.g., boomers and/or sparkers) and non-impulsive nonparametric sub-bottom profilers; and
- 100 m from all other marine mammals for use of impulsive acoustic sources (e.g., boomers and/or sparkers), except for delphinids when approaching the vessel or towed acoustic sources, shutdown is not required.

### 11.3.6 Pre-Start Clearance

PSOs will establish and monitor pre-start clearance zones. Distances to pre-start clearance zones for HRG surveys will be the same as those for shutdown zones described above.

- PSOs will conduct 30 minutes of pre-start clearance observation prior to the initiation of HRG operations.
- The pre-start clearance zones must be visible using the naked eye or appropriate technology during the entire pre-start clearance period for operations to start. If the pre-start clearance zones are not visible, source operations <180 kHz will not commence.
- Ramp-up may not be initiated if any marine mammal(s) is detected within its respective pre-start clearance zone.
- If a marine mammal is observed entering or within the pre-start clearance zones during the pre-start clearance period, relevant acoustic sources must not be initiated until the marine mammal(s) is confirmed by visual observation to have exited the relevant zone, or, until an additional time period has elapsed with no further sighting of the animal (15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm and baleen whales [including NARWs]).

### *11.3.7 Ramp-Up*

- The ramp-up procedure will not be initiated during periods of inclement conditions or if the pre-start clearance zones cannot be adequately monitored by the PSOs, using the appropriate visual technology for a 30-minute period immediately prior to ramp-up.
- Ramp-up will begin with the power of the smallest acoustic equipment at its lowest practical power output. When technically feasible, the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.
- Ramp-up activities will be delayed if marine mammal(s) enters its respective shutdown zone.
- Ramp-up will continue if the animal(s) has been observed exiting its respective shutdown zone, or until an additional time period has elapsed with no further sighting of the animal (15 minutes for odontocetes [excluding sperm whales], and 30 minutes for sperm and baleen whales [including NARW]).

### *11.3.8 Shutdowns*

- Immediate shutdown of impulsive, non-parametric HRG survey equipment other than CHRIP sub-bottom profilers operating at frequencies <180 kHz is required if a marine mammal is observed within or entering the relevant shutdown zone.
- Any PSO on duty has the authority to call for shutdown of acoustic sources. When there is certainty regarding the need for mitigation action on the basis of visual detection, the relevant PSOs must call for such action immediately.
- Upon implementation of a shutdown, survey equipment may be reactivated when all marine mammals that triggered the shutdown have been confirmed by visual observation to have exited the relevant shutdown zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes for sperm and baleen whales [including NARWs]).
- If the acoustic source is shutdown for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, the acoustic sources may be reactivated as soon as is practicable at full operational level if PSOs have maintained constant visual observation during the shutdown and no visual detections of marine mammals occurred within the applicable shutdown zone during that time.
- If the acoustic source is shutdown for a period longer than 30 minutes or PSOs were unable to maintain constant observation, then ramp-up and pre-start clearance procedures will be initiated as described in Sections 11.3.6 and 11.3.7.
- If delphinids are visually detected approaching the vessel or towed acoustic sources, shutdown is not required.

### *11.3.9 Sound Source Verification*

- In 2019, NMFS expressed concerns with HRG sound source verification measurements previously collected in offshore wind leases in the Northeast and recommended developers requesting incidental take authorization to estimate zones of potential impact using standard modeling guidance (NMFS 2020e) SouthCoast Wind did not collect SSV measurements for 2019-2021 surveys and does not plan to collect SSV measurements as part of the planned surveys pre- and post-construction.

## 11.4 UXO Detonation

For UXOs that are positively identified in proximity to planned activities on the seabed, several alternative strategies will be considered prior to detonating the UXO in place. These may include relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would a decision to detonate the UXO in place be made. If deflagration is conducted, mitigation and a monitoring measure would be implemented as if it was a high order detonation based on UXO size. Decision on removal method will be made in consultation with a UXO specialist and in coordination with the agencies with regulatory oversite of UXO. For detonations that cannot be avoided due to safety considerations, a number of mitigation measures will be employed by SouthCoast Wind. No more than a single UXO will be detonated in a 24-hour period.

### *11.4.1 Monitoring Equipment*

The equipment to be used during UXO detonations is shown in the table below (Table 58).

Table 58. Equipment use for all marine mammal monitoring vessels during pre-start clearance and post-detonation monitoring.

| Item | Daytime<br>Number on Each PSO Vessel |
|---|---|
| Reticle binoculars | 2 |
| Mounted "big-eye" binocular | 1 |
| Monitoring station for real time PAM system[1] | 1 |
| Data collection software system | 1 |
| PSO-dedicated VHF radios | 2 |
| Digital single-lens reflex camera equipped with 300-mm lens | 1 |

PSO = protected species observer; VHF=very high frequency.

[1] The selected PAM system will transmit real time data to PAM monitoring stations on the vessels and/or a shore side monitoring station.

### *11.4.2 Pre-Start Clearance*

All mitigation and monitoring zones assume the use of an NAS resulting in a 10 dB reduction of noise levels. Mitigation and monitoring zones specific to marine mammal hearing groups for the five different charge weight bins are presented in Table 59.

- A 60-minute pre-start clearance period will be implemented prior to any UXO detonation;

- The pre-start clearance zone (see distances to low-frequency cetacean thresholds in Table 59) must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the pre-start clearance zone for at least 30 minutes prior to commencing detonation;
- The pre-start clearance zone size will be dependent on the charge weight of the identified UXO, which will be determined prior to detonation. If the charge weight is determined to be unknown or uncertain, the largest pre-start clearance zone size (charge weight bin E12) will be used throughout the pre-start clearance period.
- All marine mammals must be confirmed to be out of the pre-start clearance zone prior to initiating detonation;
- If a marine mammal is observed entering or within the relevant pre-start clearance zones prior to the initiation of detonation, the detonation must be delayed;
- The detonation may commence when either the marine mammal(s) has voluntarily left the respective pre-start clearance zone and been visually confirmed beyond that pre-start clearance zone, or after 15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes for sperm and baleen whales [including NARWs]) with no further sightings.

Table 59. Mitigation and Monitoring Zones Associated with In-Situ UXO Detonation of Binned Charge Weights, with a 10 dB Noise Attenuation System.

| Marine Mammal Hearing Groups | UXO Charge Weight[1] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | E4 (2.3 kg) | | E6 (9.1 kg) | | E8 (45.4 kg) | | E10 (227 kg) | | E12 (454 kg) | | |
| | Pre-Start Clearance Zone[2] (m) | Level B Harassment Zone (m) | Pre-Start Clearance Zone (m) | Level B Harassment Zone (m) | Pre-Start Clearance Zone (m) | Level B Harassment Zone (m) | Pre-Start Clearance Zone (m) | Level B Harassment Zone (m) | Pre-Start Clearance Zone (m) | Level B Harassment Zone (m) | PAM Monitoring Zone (km) |
| **Export Cable Corridor** | | | | | | | | | | | |
| Low-Frequency Cetaceans | 800 | 2,800 | 1,500 | 4,500 | 2,900 | 7,300 | 4,200 | 10,300 | 4,900 | 11,800 | 15 |
| Mid-Frequency Cetaceans | 100 | 500 | 200 | 800 | 300 | 1,300 | 500 | 2,100 | 600 | 2,500 | 15 |
| High-Frequency Cetaceans | 2,500 | 6,200 | 3,500 | 7,900 | 4,900 | 10,100 | 6,600 | 12,600 | 7,400 | 13,700 | 15 |
| Phocid Pinnipeds | 300 | 1,300 | 500 | 2,200 | 1,000 | 3,900 | 1,900 | 6,000 | 2,600 | 7,100 | 15 |
| **Lease Area** | | | | | | | | | | | |
| Low-Frequency Cetaceans | 400 | 2,900 | 800 | 4,700 | 1,800 | 7,500 | 3,400 | 10,500 | 4,300 | 11,900 | 15 |
| Mid-Frequency Cetaceans | 50 | 500 | 50 | 800 | 100 | 1,300 | 300 | 2,200 | 400 | 2,600 | 15 |
| High-Frequency Cetaceans | 2,200 | 6,200 | 3,200 | 8,000 | 4,900 | 10,300 | 7,200 | 12,900 | 8,700 | 14,100 | 15 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phocid Pinnipeds | 100 | 1,500 | 200 | 2,400 | 600 | 3,900 | 1,200 | 6,000 | 1,600 | 7,000 | 15 |

kg = kilograms; m = meters

[1] UXO charge weights are groups of similar munitions defined by the U.S. Navy and binned into five categories (E4-E12) by weight (equivalent weight in TNT). For this assessment, four project sites (S1-S4) were chosen and modeled (see Hannay and Zykov 2021) for the detonation of each charge weight bin.

[2] Pre-start clearance zones were calculated by selecting the largest Level A threshold (the larger of either the PK or SEL noise metric). The chosen values were the most conservative per charge weight bin across each of the four modeled sites.

### 11.4.3 Visual Monitoring

- The number of vessels deployed will depend on the pre-start clearance zone size (as described in section 11.4.2) and safety set back distance from the detonation. A sufficient number of vessels will be deployed to cover the clearance and shutdown zones as described in Section 11.4.3.1 and Section 11.4.3.2.
- PSOs will visually monitor the relevant Low Frequency Cetacean pre-start clearance zone depending on the identified charge weight. This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with High Frequency cetaceans.

#### 11.4.3.1 Detonation Vessel Measures

- Three PSOs on duty on the detonation vessel;
- Three PSOs will maintain watch at all times during the pre-start clearance period and 30 minutes after the detonation event;
    - Each PSO will be responsible for monitoring a 120-degree sector with the unaided eye and reticle binoculars to provide additional coverage beyond the pre-start clearance zone away from the detonation location.
- The three visual PSOs onboard the detonation vessel will monitor out to the relevant pre-start clearance zone (shown in Table 59) at least 30 minutes prior to a detonation event; There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods.

#### 11.4.3.2 Additional PSO Vessel Measures

- Based on the relevant pre-start clearance zones (determined by the identified charge weight) for low-frequency cetaceans shown in Table 59, an additional PSO vessel will be used for UXO charge weight bins E10 and E12;
- The additional PSO vessel will circle the detonation vessel at or near the relevant pre-start clearance zone distance (4 – 5 km for charge weight bins E10 – E12);
- The additional PSO vessel will circumnavigate the detonation vessel at 7 – 10 knots during the pre-start clearance period, throughout the detonation event (as allowed by safety consideration), and during post-detonation monitoring;
- Visual monitoring will be conducted on the additional PSO vessel following the same methods as described above for the detonation vessel.
    - Additionally, the three PSOs on duty will be responsible for monitoring a 120-degree sector with the unaided eye and reticle binoculars to provide additional coverage inside the relevant pre-start clearance zone towards the detonation vessel as well as beyond the pre-start clearance zone away from the detonation location.

### 11.4.4 Acoustic Monitoring

- There will be one PAM team for all deployed PSO vessels;
- PAM will be conducted in the daylight only as no UXO will be detonated during nighttime hours;

- There will be a PAM operator stationed on at least one of the dedicated monitoring vessels (primary or secondary) in addition to the PSO; or located remotely/onshore;
- PAM will begin 60 minutes prior to a detonation event;
- PAM operator will be on duty during all pre-start clearance periods and post-detonation monitoring periods;
- Acoustic monitoring will extend beyond the Low Frequency Cetacean pre-start clearance zone for a given charge weight (Section 11.4.2);
- For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore;
- PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the detonation activity via the data collection software system;
- PAM devices used may include independent (e.g., autonomous or moored remote) systems.
- The PAM system will have the capability of monitoring up to 15 km from the detonation location.

### *11.4.5 Noise Attenuation*

SouthCoast Wind will use an NAS for all detonation events as feasible and will strive to achieving the modeled ranges associated with 10 dB of noise attenuation (see Section 6.3.2). Zones without 10 dB attenuation would be implemented if use of a big bubble curtain was not feasible due to location, depth, or safety related constraints. If a NAS system is not feasible, SouthCoast Wind will implement mitigation measures for the larger unmitigated zone sizes with deployment of vessels adequate to cover the entire pre-start clearance zones.

### *11.4.6 Seasonal Restriction*

- No UXO detonations are planned between January and April.

### *11.4.7 Post UXO Detonation Monitoring*

- Post-detonation monitoring will occur for 30 minutes.

### *11.4.8 Sound Source Verification*

- SSV measurements will be made for each UXO/MEC that must be detonated using the method summarized in Section 11.1.4.2.
- A sound field verification plan for UXO detonation will be submitted to NMFS 180 days prior to planned start of UXO detonations.

## 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. 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

Planned monitoring activities have been described in Section 11 along with the associated mitigation measures. A marine mammal sighting and detection report will be provided to NMFS as required by authorization stipulations.

**Reporting NARW Sightings**. Sightings of any NARW will be reported to the Right Whale Sighting Advisory System (RWSAS) as soon as it is practical to do so.

**Reporting Injured or Dead Marine Mammals**. SouthCoast Wind will ensure that sightings of any injured or dead protected species are reported to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622] or current) immediately, or as soon as safe to do so, regardless of whether the injury or death is caused by a Project vessel. In addition, if the injury or death was caused by a collision with a Project vessel, SouthCoast Wind will ensure that NMFS is notified of the strike immediately, or as soon as safe to do so. The notification of such strike will include the date and location (latitude/longitude) of the strike, the name of the vessel involved, and the species identification or a description of the animal, if possible. If a Project activity is responsible for the injury or death, SouthCoast Wind will supply a vessel to assist in any salvage effort as requested by NMFS.

**Report of Activities and Observations.** SouthCoast Wind will provide NMFS with a report within 90 calendar days following the completion of construction activities, including a summary of the construction activities and an estimate of the number of marine mammals taken during these activities. During construction, weekly reports briefly summarizing sightings, detections, and activities will be provided to NMFS and BOEM on the Wednesday following a Sunday-Saturday period.

**Report Information.** Data on all protected-species observations will be recorded and based on standards of marine mammal observer collection data by the PSOs. The information will include dates, times, and locations of survey operations; time of operation; location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (e.g., behavioral disturbances or injury/mortality).

# 14 Suggested Means of Coordination

SouthCoast Wind will coordinate the planned marine mammal monitoring program associated with construction activities off the U.S. 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.

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# Appendix A - Underwater Acoustic Modeling

# Appendix B - Distances to Acoustic Thresholds for High Resolution Geophysical Sources