Atlantic Shores Offshore Wind

Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization

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ATLANTIC SHORES
offshore wind

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Executive Summary

Atlantic Shores Offshore Wind, LLC (Atlantic Shores) is requesting a Letter of Authorization (LOA) pursuant to section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) for the unintentional and non-lethal take by both Level A and Level B harassment of small numbers of marine mammals during the construction of two offshore wind energy generation projects (referred to herein as Project 1 and Project 2) within Lease Area OCS-A 0499. The Projects will be located in the approximately 102,124-acre (413.3-square kilometer [km^2]) area of Lease Area OCS-A 0499 (also referred to as the Wind Turbine Area [WTA]). Project 1 is located in the western 54,175 acres (219.2 km^2) of the Lease Area and Project 2 is located in the eastern 45,013 acres (182.2 km^2) of the WTA, with a 2,936-acre (11.9-km^2) Overlap Area that could be used by either Project 1 or Project 2 (Figure 1). Within the WTA, the Projects will include a combined maximum of up to 200 wind turbine generators (WTGs), inclusive of the Overlap Area; up to 10 small offshore substations (OSSs), up to five medium OSSs, or up to four large OSSs; and up to one permanent meteorological (met) tower. Only one OSS size is anticipated within a single project. However, different OSS sizes could be used between Project 1 and Project 2.

At its closest point, the WTA is approximately 8.7 miles (mi) (14 kilometers [km]) from the New Jersey shoreline. Water depths in the WTA range from 62 to 121 feet (ft) (19 to 37 meters [m]), gradually increasing with distance from shore. Within the WTA, the WTGs and OSSs for Project 1 and Project 2 will be connected by two separate, electrically distinct systems of inter-array cables and/or inter-link cables. Energy from the OSSs will be delivered to shore by export cables that will travel within designed Export Cable Corridors (ECCs) from the WTA through federal and New Jersey state waters to one or two landfall sites on the New Jersey coastline.

Impact pile driving of monopile and jacket pin piles during foundation installation, high-resolution geophysical (HRG) surveys, and vibratory piling during cofferdam installation and removal could produce sounds that exceed the threshold criteria for marine mammal harassment and are the focus of this LOA request.

To estimate potential Level A and Level B harassment resulting from impact pile driving, JASCO Applied Sciences (JASCO) performed underwater acoustic modeling of these sounds on behalf of Atlantic Shores. The basic modeling approach characterizes the sounds produced by the source, determines how the sounds propagate within the surrounding environment, then estimates species-specific exposure probabilities by combining the computed sound fields with simulated animal movements in representative scenarios. The resulting species-specific exposure probabilities are then converted into predicted numbers of individuals of each species that could be exposed to sounds above the Level A and Level B acoustic thresholds to generate take estimates for impact pile driving based on the number of piles installed monthly and each species' monthly density within a 3.9 km buffer around the WTA.

The modeling assumed piled foundations for 200 WTGs, one met tower, and up to four large OSSs. The modeling considered the use of a total of four large OSSs because this results in the largest number of pin piles as well as the greatest number of pile driving days and thus represents the maximum design scenario for OSS installation. Three construction schedules were modeled. Construction Schedule 1 assumed all WTGs and the met tower would be installed on monopile foundations, with a monopile installation rate of one monopile per day, and that the OSSs would be installed on piled jacket foundations with a pin pile installation rate of four pin piles per day. Construction Schedule 2 assumed all WTGs, the met tower, and OSSs would be installed on piled jacket foundations with a pin pile installation rate of four pin piles per day. Schedules 1 and 2 assumed foundation installation spanning over two years. Construction Schedule 3 assumed that all foundations would be installed within one year, with monopiles installed at a rate of up to two per day, and all four OSSs installed in the same year at a rate of four pin piles per day. All construction schedules assumed 10 dB of sound attenuation and a proposed pile installation schedule from May through December to avoid and minimize the impacts to the North Atlantic right whale (NARW) (*Eubalaena glacialis*).

Additionally, for this LOA request, all three construction schedules assumed a start year for impact pile driving of foundations of 2026. As a conservative measure, Construction Schedule 2 was used in calculating takes for this LOA request because it results in a greater number of estimated Level A takes. Overall construction activities were assumed to start in 2025, with cofferdam installation and removal in 2025 and 2026, HRG surveys occurring during 2025–2029. The yearly breakdown of construction activities can be found in Table 7.

JASCO performed underwater acoustic modeling of vibratory piling required for cofferdam installation and removal and used this modeling to make density-based exposure estimates and take calculations based on the maximum density of each marine mammal species during the September to May period when installation and removal activities are scheduled to occur. Potential Level B harassment resulting from HRG surveys was assessed by Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) on behalf of Atlantic Shores. Estimates assumed the maximum average seasonal densities of marine mammals within the HRG survey area and the zone of influence for the equipment producing the largest range to the Level B threshold. This assessment assumed 60 days of surveys during each of the five years from 2025–2029.

This application, which was deemed adequate and complete by NMFS on August 25, 2022, used density estimates that were the best available at the time that it was submitted. More recent density estimates are now available from the 2022 Duke University Marine Geospatial Ecology Laboratory (MGEL) Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016, 2022). These models include updates for all species and higher resolution density information. Updates to the density, exposure, and take estimates using the 2022 MGEL models will be provided to NMFS in an external memo no later than September 28, 2022.

Tables 1 and 2 present the requested Level A and Level B takes by year for all activities conducted during the construction of Atlantic Shores Project 1 and Project 2 full buildout. As summarized in Tables 1 and 2, no level A exposures were predicted for Atlantic spotted dolphins, short-beaked common dolphins, bottlenose dolphins, pilot whales, sperm whales and the NARW. For the NARW, specific targeted mitigation measures will be implemented during pile driving to ensure that no Level A take occurs. Exposure estimates predicted from modeling results indicate that Level A takes are zero or negligible for most species and are greatly reduced when sound attenuation mitigation is employed. Every effort will be made to avoid Level A takes through mitigation; however, Level A takes are being requested for impact pile driving as a precaution in the unlikely scenario that a marine mammal enters their respective Level A ensonified zone after pile driving has begun, and it is not feasible from an operational or safety perspective to cease the pile driving activity. Level A harassment associated with pile driving activities will be minimized to the maximum extent possible for all species and avoided for the NARW by implementing the mitigation measures described in Section 11.

Due to the implementation of mitigation and monitoring measures, in combination with the behavior of marine mammal species (i.e., their transient nature and their ability to move away from the source of potential harassment), it is unlikely that HRG surveys will result in the Level A harassment of marine mammals. Given the discrete frequency bands and small area of sound propagation emitted from HRG equipment, BOEM has concluded that injury to marine mammals (i.e., Level A harassment) is not expected as sound diminishes rapidly from the equipment (BOEM, 2018). Therefore, Level A take calculations have not been performed and Level A take from HRG surveys has not been requested for any marine mammal species. Atlantic Shores is only requesting authorization for the incidental take of small numbers of marine mammals within each of the Survey Areas by Level B harassment. Similarly, Level A take is not being requested for vibratory piling during cofferdam installation and removal based on mitigation measures, and because the ranges to the Level A thresholds are short and the behavior of the animals make it unlikely that they will remain within the Level A SEL range long enough to sustain PTS onset.

Table 1. Requested Level A and Level B takes by year for all activities conducted during Atlantic Shores construction of Project 1 and Project 2.

Species		Stock Size	Year 1			Year 2			Year 3			Year 4			Year 5		
			Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]
LF	Fin whale[b]	6802	0	3[e]	0.04	12	35	0.69	10	26	0.53	0	1	0.01	0	1	0.01
	Minke whale	21968	0	3[e]	0.01	5	46[e]	0.23	4	34	0.17	0	1	<0.01	0	1	<0.01
	Humpback whale	1396	0	4	0.29	3	13	1.15	2	7	0.64	0	1	0.07	0	1	0.07
	North Atlantic right whale[b]	368	0	7[e]	1.90	0	15	4.08	0	7[c]	1.90	0	3	0.82	0	3	0.82
	Sei whale[b]	6292	0	5[e]	0.08	1	8[c,e]	0.14	1	5[c]	0.10	0	2	0.03	0	2	0.03
MF	Atlantic spotted dolphin	39921	0	200[d,e]	0.50	0	300[c,d,e]	0.75	0	200[c,d]	0.50	0	100[d]	0.25	0	100[d]	0.25
	Atlantic white-sided dolphin	93233	0	25[e]	0.03	1	231[e]	0.25	1	161	0.17	0	3	<0.01	0	3	<0.01
	Short-beaked common dolphin[f]	172974	0	118	0.07	0	311	0.18	0	250	0.14	0	93	0.05	0	93	0.05
	Bottlenose dolphin, coastal	6639	0	1071	16.13	0	576[c]	8.68	0	104[c]	1.57	0	90	1.36	0	90	1.36
	Bottlenose dolphin, offshore	62851	0	182	0.29	0	4343	6.91	0	3708	5.90	0	182	0.29	0	182	0.29
	Risso's dolphin	35215	0	60[d,e]	0.17	1	90[c,d,e]	0.26	1	60[c,d]	0.17	0	30[d]	0.09	0	30[d]	0.09
	Long-finned pilot whale	39215	0	40[d,e]	0.10	0	60[c,d,e]	0.15	0	40[c,d]	0.10	0	20[d]	0.05	0	20[d]	0.05
	Short-finned pilot whale	28924	0	6[e]	0.02	0	12[c,e]	0.04	0	6[c]	0.02	0	0	0	0	0	0
	Sperm whale[b]	4349	0	3[e]	0.07	0	5[c,e]	0.11	0	3[c]	0.07	0	1	0.02	0	1	0.02
HF	Harbor porpoise	95543	0	76	0.08	32	405	0.46	21	94	0.12	0	29	0.03	0	29	0.03
PPW	Gray seal	27300	0	112	0.41	1	241	0.89	1	49	0.18	0	41	0.15	0	41	0.15
	Harbor seal	61336	0	200	0.33	1	489	0.80	1	59	0.10	0	41	0.07	0	41	0.07

[a] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for impact pile driving rounded up to one average group size.

[d] Take estimate for HRG surveys rounded up to one group size.

[e] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

Table 2. Summary of total Level A and Level B takes for all activities conducted during Atlantic Shores construction of Project 1 and Project 2.

Species		Stock size	5 Year total		
			Level A	Level B	Max percent[a]
LF	Fin whale[b]	6,802	21	65[e]	1.26
	Minke whale	21,968	9	83[e]	0.42
	Humpback whale	1,396	4	25	2.08
	North Atlantic right whale[b]	368	0	33[e]	8.97
	Sei whale[b]	6,292	1	21[c,e]	0.35
MF	Atlantic spotted dolphin	39,921	0	900[c,d,e]	2.25
	Atlantic white-sided dolphin	93,233	1	421[e]	0.45
	Short-beaked common dolphin[f]	172,974	0	864	0.50
	Bottlenose dolphin, coastal	6,639	0	1931[c]	29.09
	Bottlenose dolphin, offshore	62,851	0	8597	13.68
	Risso's dolphin	35,215	1	270[c,d,e]	0.77
	Long-finned pilot whale	39,215	0	180[c,d,e]	0.46
	Short-finned pilot whale	28,924	0	24[c,e]	0.08
	Sperm whale[b]	4,349	0	13[c,e]	0.30
HF	Harbor porpoise	95,543	52	633	0.72
PPW	Gray seal	27,300	1	483	1.77
	Harbor seal	61,336	2	829	1.35

[a] Max percent is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for impact pile driving rounded up to one average group size.

[d] Take estimate for HRG surveys rounded up to one group size, except for short-beaked common dolphins which are one group size multiplied by estimated exposures (see Appendix C).

[e] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.).

[d] Take estimate for short-beaked common dolphins for impact pile driving is one average group size multiplied by the number of pile driving days.

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Acronyms and Abbreviations

AMAPPS	Atlantic Marine Assessment Program for Protected Species
BIA	Biologically Important Area
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetacean and Turtle Assessment Program
COP	Construction and Operations Plan
dB	decibel
DP	dynamic positioning
DPS	Distinct Population Segment
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ft	feet
FWRAM	Full Wave Range Dependent Acoustic Model
h	hour
HF	high frequency (cetacean hearing group)
HRG	high resolution geophysical
Hz	Hertz
in	inch
JASMINE	JASCO Animal Simulation Model Including Noise Exposure
kg	kilogram
kHz	kilohertz
kJ	kilojoule
km	kilometer
$\mathrm{L_E}$	cumulative sound exposure level
$L_{E,\mathrm{24h}}$	cumulative sound exposure level over a 24-hour period
LF	low frequency (cetacean hearing group)
LOA	Letter of Authorization
L_p	sound pressure level
L_{pk}	level of peak sound pressure
m	meter
m/s	meters per second
MF	mid-frequency (cetacean hearing group)
mi	mile
MMPA	Marine Mammal Protection Act
MONM	Marine Operations Noise Model
MW	megawatt
NARW	North Atlantic right whale
NEAq	New England Aquarium
NEFSC	Northeast Fisheries Science Center
NJ	New Jersey

NJ ENSP	New Jersey Department of Environmental Protection Endangered and Nongame Species Program
NJWEA	New Jersey Wind Energy Area
NM	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OSP	Optimum Sustainable Population
OSS	Offshore substation
PAM	passive acoustic monitoring
PDSM	Pile Driving Source Model
PK	level of peak sound pressure
PSO	protected species observer
PTS	permanent threshold shift
PW	phocid in water (hearing group)
rms	root mean square
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
$\mathrm{SEL}_{\mathrm{cum}}$	cumulative sound exposure level
SL	sound level
SPL	sound pressure level
TTS	temporary threshold shift
U.S.	United States
WTA	Wind Turbine Area
WTG	wind turbine generator
μPa	micropascal

1. Description of Specified Activity

This Letter of Authorization (LOA) request is for the unintentional and non-lethal take of marine mammals incidental to proposed construction of two offshore wind energy generation projects (the Projects) within Lease Area OCS-A 0499 (the Lease Area) by Atlantic Shores Offshore Wind, LLC (Atlantic Shores). In March of 2021, Atlantic Shores submitted a Construction and Operations Plan (COP) requesting authorization of the Projects under the National Environmental Policy Act. The Projects were accepted as a covered project under Title 41 of the Fixing America's Surface Transportation Act (FAST-41) on April 13, 2021, and qualified for inclusion on the FAST-41 Permitting Dashboard. The federal permitting schedule for the Projects listed on the FAST-41 Permitting Dashboard was established by the Federal Permitting Improvement Steering Council (FPISC), which was created under FAST-41 with responsibility for overseeing interagency coordination during a covered project's environmental review and decision-making process. The LOA request contained herein has been included as part of this coordinated federal review process and will tier from BOEM's cooperative agency National Environmental Policy Act (NEPA) review process.

The 14 specific items required for this application, as set out by 50 Code of Federal Regulations (CFR) 216.104 Submission of Requests, are addressed in Sections 1–14 of this application. This LOA request is focused on those activities (e.g., pile driving, HRG surveys, and vibratory installation of cofferdam sheet piles) that may result in the incidental take by both Level A (impact pile driving only) and Level B (all three activities) harassment of small numbers of marine mammals during the construction of the Projects.

1.1. Introduction and Overview

Atlantic Shores is a 50/50 joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc.) and Shell New Energies US LLC. Atlantic Shores is proposing to develop two offshore wind energy generation projects within the Lease Area. The Lease Area is approximately 102,124 acres (413.3 square kilometers [km^2]) in size and is located on the Outer Continental Shelf (OCS) within the New Jersey Wind Energy Area (NJWEA) (see Figure 1). The NJWEA was identified as suitable for offshore renewable energy development by the Bureau of Ocean Energy Management (BOEM) through a multi-year, public environmental review process. Through this review process, the NJWEA was sited to exclude areas of high value habitat and conflicting water and air space uses (see https://www.boem.gov/renewable-energy/state-activities/new-jersey-activities and Volume I of the COP Section 1.3.1).

In accordance with the New Jersey Offshore Wind Economic Development Act, on June 30, 2021, the New Jersey Board of Public Utilities awarded Atlantic Shores an Offshore Renewable Energy Certificate (OREC) allowance to deliver approximately 1,510 megawatts (MW) of offshore renewable energy into the State of New Jersey. The project that will be developed under this OREC award, referred to as Project 1, will be owned and operated by Atlantic Shores Offshore Wind Project 1, LLC ("Atlantic Shores Project 1 Company"). Pursuant to New Jersey Executive Orders #8 and #92, the State will be awarding additional OREC allowances to offshore wind energy projects through a competitive solicitation process every two years through 2026. Atlantic Shores expects to bid into these future New Jersey offshore wind energy solicitations for subsequent projects. Atlantic Shores' second project, referred to as Project 2, will be owned and operated by Atlantic Shores Offshore Wind Project 2, LLC ("Atlantic Shores Project 2 Company"), and is being developed to support these future New Jersey solicitations. Project 1 and Project 2 are collectively referred to as "the Projects."

Atlantic Shores is the owner and an affiliate of both the Atlantic Shores Project 1 Company and the Atlantic Shores Project 2 Company. Accordingly, for ease of reference, the term “Atlantic Shores” is used throughout this LOA request to refer interchangeably to the Project Companies.

Atlantic Shores’ proposed offshore wind energy generation facilities for Projects 1 and 2 will be located in the approximately 102,124 acre (413.3-km^2) Lease Area (also referred to as the Wind Turbine Area [WTA]) located about 8.7 mi (14 km) from the New Jersey shoreline at the closest point. Project 1 is located in the western 54,175 acres (219.2 km^2) of the WTA and Project 2 is located in the eastern 45,013 acres (182.2 km^2) with a 2,936-acre (11.9-km^2) Overlap Area that could be used by either Project. The Overlap Area is included in the event engineering or technical challenges arise at certain locations in the WTA, to provide flexibility for final selection of a wind turbine generator (WTG) supplier for the Projects (which will determine the individual MW capacity and final number of WTG positions needed to meet the OREC award for Project 1 and anticipated award for Project 2), and for environmental or other considerations. All positions in the Overlap Area are intended for development and are required to meet the Projects’ purpose and need (see Volume I of the COP Section 1.2). Figure 1 provides an overview of the WTA, depicting the boundaries for Project 1, Project 2, and the Overlap Area. Water depths in the WTA range from 19 to 37 m, generally gradually increasing with distance from shore.

In addition to the WTA, the Projects will include two offshore Export Cable Corridors (ECCs) within federal and New Jersey state waters. The Offshore Project Area shown on Figure 1 includes the federal and state waters and underlying seabed associated with the WTA (which includes Project 1, Project 2, and the Overlap Area) and the two ECCs. The Projects also include two onshore interconnection cable routes, two onshore substation and/or converter station sites, and a proposed operations and maintenance facility in New Jersey.

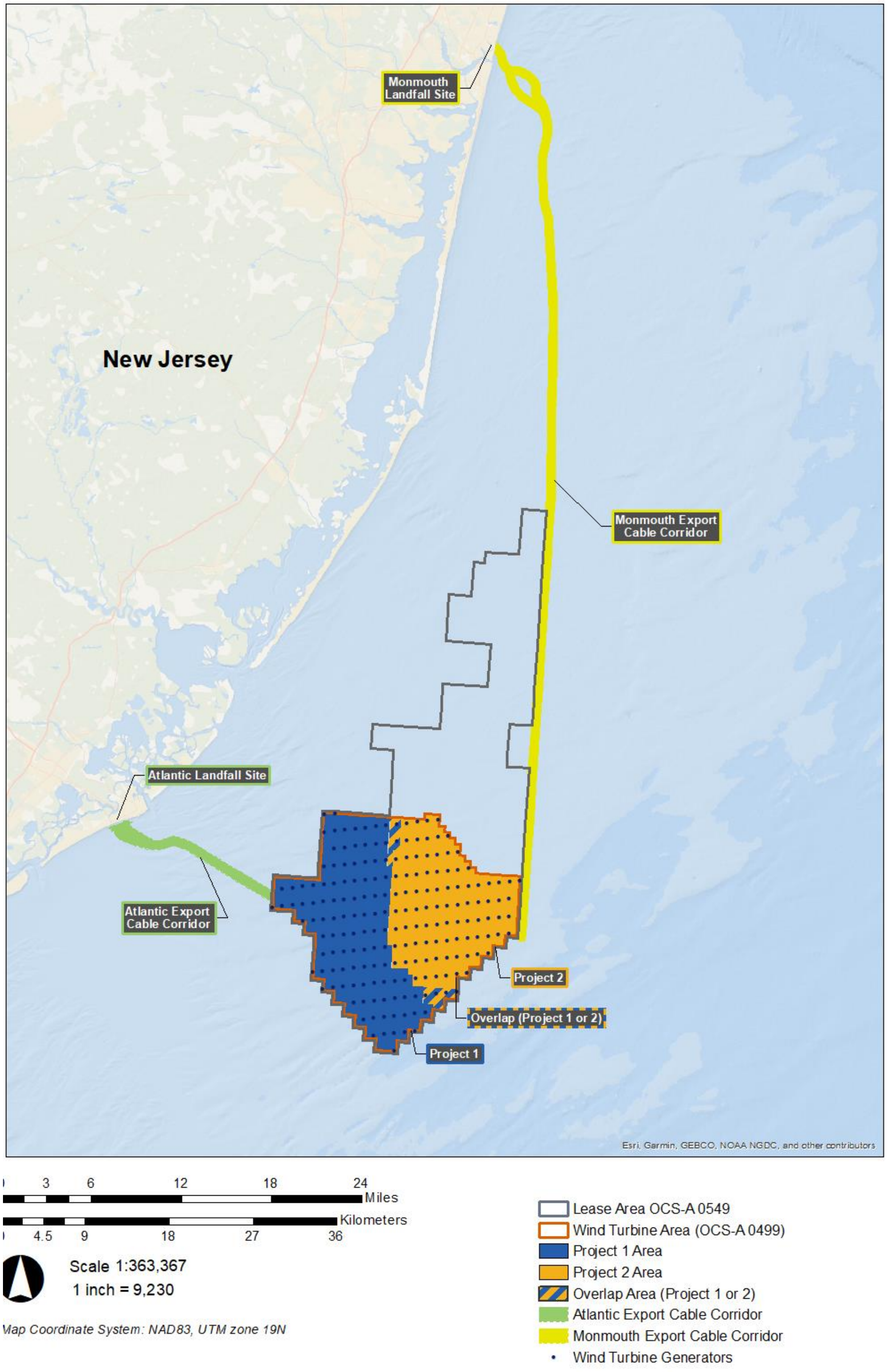

Figure 1. Map showing location of Atlantic Shores Offshore Project Area in relation to the New Jersey shoreline.

Within the WTA, the Projects will include:

- A combined maximum of up to 200 WTGs, inclusive of the Overlap Area[1]:
    - Project 1: a minimum of 105 WTGs and up to a maximum of 111 WTGs
    - Project 2: a minimum of 89 WTGs and up to a maximum of 95 WTGs
- Up to a total of 10 offshore substations (OSSs):
    - Up to five for Project 1 (five small, two medium or two large)
    - Up to five for Project 2 (five small, three medium or two large)
- Up to one permanent meteorological (met) tower, to be installed during Project 1 construction
- Up to four temporary meteorological and oceanographic (metocean) buoys[2]:
    - Three for Project 1
    - One for Project 2

Other Project components include:

- Up to eight temporary cofferdams[3],
    - Four at the Atlantic landfall site for Project 1.
    - Four at the Monmouth landfall for Project 2.

Project 1 and Project 2 will be electrically distinct, and energy from the Projects' OSSs will be delivered to shore via 230 kV to 275 kV HVAC and/or 320 kV to 525 kV high voltage direct current (HVDC) export cables. Thus, for both Projects, a total of up to eight export cables will be installed. The export cables will traverse federal and state waters to deliver energy from the OSSs to landfall sites in New Jersey. The Atlantic ECC travels from the western tip of the WTA westward to the Atlantic Landfall Site in Atlantic City, New Jersey and has a total length of approximately 12 mi (19 km). The approximately 61 mi (98 km) long Monmouth ECC travels from the eastern corner of the WTA along the eastern edge of the Lease Area to the Monmouth Landfall Site in Sea Girt, New Jersey. Both Projects 1 and 2 have the potential to use either ECC, and offshore export cables for each Project may also be co-located within an ECC.

During construction and operation of the Projects, Atlantic Shores will use port facilities in New Jersey, New York, the Mid-Atlantic, and/or New England. In addition, some components, materials, and vessels could come from United States (U.S.) Gulf Coast or international ports. To support the Projects' operations, Atlantic Shores is also proposing to establish an operations and maintenance (O&M) facility in Atlantic City, New Jersey.

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[1] The number of WTGs in Project 1, Project 2, and the associated Overlap Area will not exceed 200 WTG locations. For example, if Project 1 includes 105 WTGs (the minimum) then the Overlap Area would be incorporated into Project 2 which would include the remaining 95 WTGs; and conversely if the Overlap Area is incorporated into Project 1 such that it includes 111 WTGs, then Project 2 would be limited to 89 WTGs. Each Project may also use only part of the Overlap Area.

[2] Metocean buoys do not have any active acoustic components. The metocean buoys collect different data than that which is collected on the met towers. The buoys deployed assesses metocean conditions prior to construction for 1-2 years, where the offshore met tower is a permanent measurement device during operational years. The quality of measurements is much higher with an offshore met tower and allows measurement of additional local conditions to better assess operational efficiency of the wind farm. Critical information such as the atmospheric stability impact on wake losses, impact of turbulence intensity on wake losses and structural loads can be compared to pre-construction estimates and used to validate the industry's assumptions. It also could provide an excellent potential platform for other R&D projects and data collection such as those related to climate change.

[3] Each project could utilize up to 4 cofferdams at a single landfall site.

1.2. Offshore Project Elements and Construction Activities

In creating its COP, Atlantic Shores applied a Project Design Envelope (PDE) approach as outlined in BOEM's draft PDE guidance (BOEM 2018). The Projects' PDE includes a reasonable range of designs for proposed components (e.g., foundations, WTGs, export cables, onshore elements) and installation techniques (e.g., use of anchored, jack-up, or dynamic positioning [DP] vessels). Identifying a range of design parameters and installation methods allows BOEM to analyze the maximum impacts that could occur from the Projects while providing Atlantic Shores with the flexibility to optimize the Projects within the approved PDE during later stages of the development process. Potential components and installation techniques within the Projects' PDE that are relevant to the LOA request include impact pile driving of the WTGs, met tower and OSS foundations (i.e., monopile and jackets), high-resolution geophysical (HRG) surveys, and vibratory cofferdam installation and removal, which could produce sounds that exceed the threshold criteria for harassment of marine mammals. These activities are described in more detail in the following sections. Other project-related activities including submarine cable installation; fisheries research; topside installation of the WTGs, OSSs, and a met tower; met buoy deployment; and operation of the Projects will not produce underwater noise levels that could result in the incidental take of marine mammals (see Volume II of the COP Section 4.7.2 and Appendix II-L) and are therefore not further evaluated within the context of this specific LOA request. Similarly, suction bucket and gravity-based foundations may be included within the Projects but were not analyzed as piled foundations represent the most conservative scenario for hydroacoustic modeling and potential take estimates. Additionally, Atlantic Shores conducted a Munitions and Explosives of Concern (MEC) Hazard Assessment. Unexploded Ordnances (UXO) may produce sounds that cause acoustic exposure injury. The assessment suggests that encountering MEC would be low, and, with mitigation strategies in place, UXOs would be avoided (see Volume II of the COP Section 2.1.1.2.4 and Appendix II-A3b). Effects to marine mammal habitats and associated prey species are also expected to result in negligible impacts and are discussed in further detail in Sections 9 and 10.

For the purpose of estimating takes resulting from impact pile driving in this LOA request, assumptions were made regarding the numbers and types of foundations as well as the timing of pile installation that fall within the PDE to assess the maximum potential impact that could occur. The model assumptions are described in detail in the following sections, and listed here briefly as follows:

- A total of 201 WTG type foundations (200 WTGs plus 1 met tower) and four large OSS jacket foundations would be installed for Project 1 and Project 2 combined;
- A maximum of 112 WTG foundations (111 WTGs plus 1 met tower) and 2 large OSSs would be installed for Project 1, including the Overlap Area of 6 WTG foundations;
- A maximum of 95 WTG foundations and 2 large OSSs would be installed for Project 2, including the Overlap Area of 6 WTG foundations;
- WTG and met tower foundations could be either monopile or four-legged jacket foundations with one pin pile per leg (total of 4 pin piles per foundation);
- Monopile foundations would be installed at a rate of either one per day or 2 per day;
- Jacket foundations would be installed at a rate of four pin piles per day;
- A total of four large OSSs on eight-legged jacket foundations with 3 pin piles per leg (96 pin piles total) would be installed for Project 1 and Project 2 combined;
- The monopile diameter would be 15 m and the jacket pin pile diameter would be 5 m;

- Foundations would be installed during the months shown in the construction schedules provided in Section 2.2; and
- Three construction schedules were compared. Schedule 2, which assumed 201 WTG foundations installed on four-legged jacket foundations (804 pin piles total) and four large OSSs installed on eight-legged jacked foundations (96 pin piles total), resulted in the highest number of exposures and was carried forward in the take estimation as it represents the most conservative scenario.

To estimate takes resulting from HRG surveys, the maximum per-day zone of influence (ZOI) was multiplied by the seasonal average density for species in the area and scaled by the number of active survey days. Sparkers were found to have the longest distance to behavioral disruption threshold (Level B) at 141 m and were used to conservatively estimate the ensonified area. Vessels are expected to travel a maximum of 55 km/day resulting in a daily ZOI of 15.57 km^2. 60 active survey days are assumed in the season.

To estimate takes resulting from cofferdam installation and removal, JASCO performed underwater acoustic modeling of the vibratory piling used for cofferdam installation and removal to obtain ranges to acoustic threshold used to calculate the ZOI. Atlantic Shores is assuming 109 sheet piles per cofferdam, for a total of 872 sheet piles for all 8 cofferdams, with four cofferdams at each landfall site (Atlantic and Monmouth). The ZOI was multiplied by the maximum monthly density of each marine mammal species during the September to May period, assuming 8 days of installation and 8 days of removal of cofferdam sheet piles at each of the two landing site locations, for a total of 16 days at each site to obtain exposure estimates.

1.2.1. Foundation and Piling Equipment

This LOA request is focused on project-related activities that produce sounds that could exceed the threshold criteria for Level A or Level B harassment; specifically, impact pile driving of monopiles or piled jackets. The monopiles considered could have a maximum diameter of 15 meters (m)[4] at the seabed and jacket pin piles could have a maximum diameter of 5 m at the seabed. Diagrams of the piled foundation types are shown in Figure 2.

As noted in Section 1.1, a combined maximum of up to 200 WTGs inclusive of the Overlap Area[5] and one met tower will be installed either on monopile or jacket foundations with up to four pin piles each:

- Project 1: a minimum of 105 WTGs to a maximum of 111 WTGs.
- Project 2: a minimum of 89 WTGs to a maximum of 95 WTGs.

WTGs and the met tower could be installed on up to four-legged jacket foundations, resulting in a total maximum of 804 jacket pin piles across both Projects. For the purposes of this LOA request, it is assumed that if WTGs and the met tower are installed on jacket foundations, that they would be on four-legged foundations for conservatism.

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[4] While the maximum diameter considered for monopiles is 15 m, acoustic and exposure modeling of 12 m monopiles was also completed in Appendix A for comparison. This LOA request does not request take for installing monopiles; however, exposure estimates for installing 15 m monopiles, assuming Construction Schedule 1, are reported in Section 6.2.5.

[5] The number of WTGs in Project 1, Project 2, and the associated Overlap Area will not exceed 200 WTG locations. For example, if Project 1 includes 105 WTGs (the minimum) then the Overlap Area would be incorporated into Project 2 which would include the remaining 95 WTGs; and conversely if the Overlap Area is incorporated into Project 1 such that it includes 136 WTGs, then Project 2 would be limited to 64 WTGs. Each Project may also use only part of the Overlap Area.

Up to 10 small OSSs, up to five medium OSSs, or up to four large OSSs will serve as common collection points for power from the WTGs and also serve as the origin for the export cables that deliver power to shore:

- Project 1: up to five small OSSs, two medium OSSs, or two large OSSs.
- Project 2: up to five small OSSs, three medium OSSs, or two large OSSs.

Small OSSs could be installed on four-legged jacket foundations with one pin pile per leg, resulting in a total of 40 OSS pin piles across both Projects. Medium OSSs could be installed on six-legged jacket foundations with up to two pin piles per leg, resulting in a total of 60 maximum OSS pin piles across both Projects. Large OSSs could be installed on eight-legged jacket foundations with up to three pin piles per leg, resulting in a total of 96 maximum OSS pin piles across both Projects. The OSS size within each Project is expected to be consistent; however, the size could differ between Projects (for example, Project 1 could include two medium OSSs while Project 2 could include two large OSSs). This LOA request conservatively considers the use of a total of four large OSSs (two large for Project 1 and two large for Project 2) because this results in the greatest number of pin piles and thus represents the maximum design scenario for OSS installation. Accordingly, the following sections of this LOA request refer only the maximum design scenario of four large OSSs (24 pin piles each).

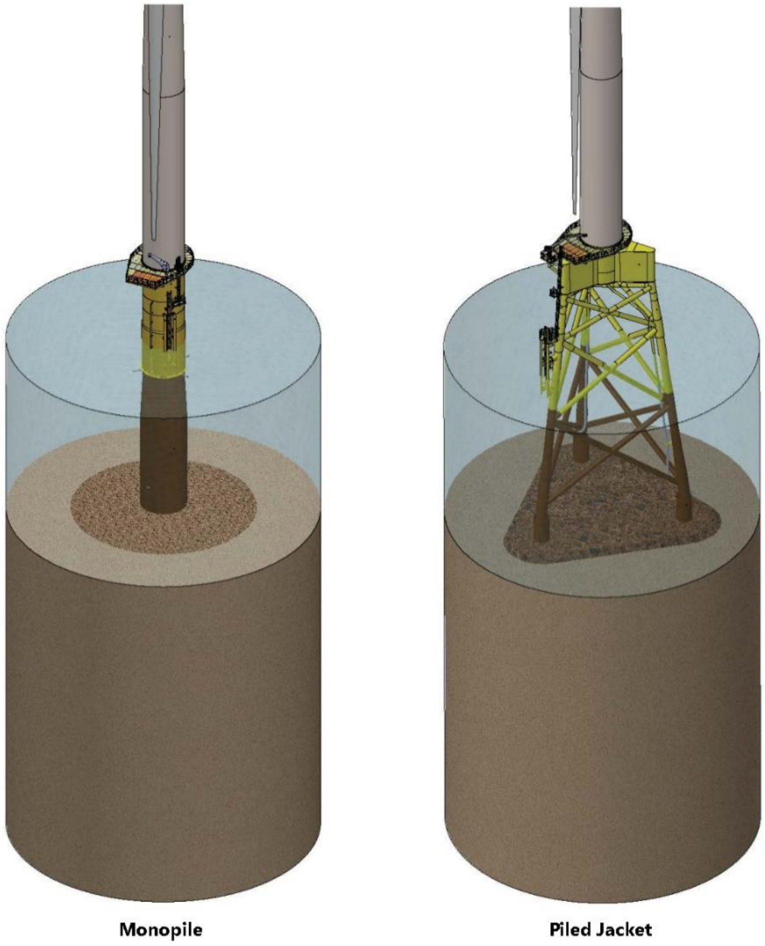

Figure 2. Piled foundations. Source: Fig. 4.2-1 of Atlantic Shores Constructions and Operations Plan Volume I.

At each foundation location, a crane on the installation vessel will lift the monopile or each piled jacket component from the transportation vessel into a vertical position and lower it to the seabed. Once the monopile or jacket pin pile is lowered to the seabed, the weight of the pile itself will cause the pile to sink a distance into the seabed. To achieve target penetration depth the pile must then be driven into the seabed using a hydraulic hammer. The maximum expected hammer size for installation of monopiles is up to 4,400 kilojoules (kJ) whereas the maximum expected hammer size for jacket pin piles is 2,500 kJ. It is anticipated that it will take a maximum of 7 to 9 hours to drive one monopile and that a maximum of 2 monopiles could be driven per day. A single monopile could conservatively take up to 9 hours of pile driving to install, but it is expected that a typical duration is approximately 6 hours of pile driving per monopile. If two monopiles are installed in the same day it is expected that the total duration would be approximately 12 hours. These numbers are best estimates. Actual durations may vary depending on location specific soil conditions, seastates, equipment, and other factors. Modeling assumed installation of either one or two monopiles per day. For jackets, it is expected that all pin piles for a single WTG jacket foundation (i.e., up to four piles) could be installed in one day. Pin piles are estimated to take approximately 3 hours per pile for a total of 12 hours per day. Nighttime pile driving could only occur if unforeseen circumstances prevent the completion of pile driving during daylight hours and it is necessary to continue piling during the night to protect asset integrity or safety. No concurrent pile driving will occur within the WTA. A complete description of the piling scenarios and schedules is provided in Section 2.2.

1.2.2. HRG Survey Equipment

Atlantic Shores has evaluated a range of possible HRG survey equipment that would be necessary to support seabed assessments across the Survey Area during the specified timeframe associated with the proposed activities. This evaluation has been based on both the technical and regulatory requirements for project development as well as the type of survey equipment that has been recently deployed in support of offshore wind projects along the Atlantic Coast. The categories of representative HRG survey equipment with operating frequencies <180 kilohertz (kHz) that are anticipated for use are presented in Table 3 This equipment will either be mounted to or towed behind the survey vessel at a typical survey speed of approximately 3.5 knots (6.5 km) per hour.

Operational parameters presented in Table 1 were obtained from the following sources: Crocker and Fratantonio (2016); manufacturer specifications; personal communication with manufacturers; agency correspondence; and Atlantic Shores. The operational source level, frequency, and beamwidth were used in the NOAA Fisheries Level B spreadsheet tool for calculating the distance to the Level B threshold. Manufacturer specifications are included in Attachment A.

Table 3. Representative equipment specification with operating frequencies below 180 kHz

HRG Survey Equipment (Sub-Bottom Profiler)	Representative Equipment Type	Operating Frequencies Ranges (kHz)	Operational Source Level Ranges ($\mathrm{dB}_{\mathrm{RMS}}$)	Beamwidth Ranges (degree)	Typical Pulse Durations RMS_{90} (millisec)	Pulse Repetition Rate (Hz)
Sparker	Applied Acoustics Dura-Spark 240	0.01 to 1.9[a]	203[a]	180	3.4[a]	2
	Geo Marine Geo-Source	0.2 to 5[b]	195[b]	180	7.2[b]	0.41
Chirp	Edgetech 2000-DSS	2 to 16[b]	195[c]	24[d]	6.3	10
	Edgetech 216	2 to 16	179[e]	17, 20, or 24	10	10
	Edgetech 424	4 to 24[f]	180[f]	71[f]	4	2
	Edgetech 512i	0.7 to 12[f]	179[f]	80[f]	9	8
	Pangeosubsea Sub-Bottom Imager™	4 to 12.5[d]	190[d,g]	120[d]	4.5	44
INNOMAR	INNOMAR SES-2000 Medium-100 Parametric [h]	85 to 115[d]	241[i]	2[d]	2	40
	INNOMAR deep -36 Parametric [h]	30 to 42	245	1.5	0.15 to 5	40

[a] The operational source level for the Dura-Spark 240 is assigned based on the value closest to the field operational history of the Dura-Spark 240 [operating between 500–600 J] found in Table 10 in Crocker and Fratantonio (2016), which reports a 203 $\mathrm{dB}_{\mathrm{RMS}}$ for 500 J source setting and 400 tips. Because Crocker and Fratantonio (2016) did not provide other source levels for the Dura-Spark 240 near the known operational range, the SIG ELC 820 @750 J at 5m depth assuming an omnidirectional beam width was considered as a proxy or comparison to the Dura-Spark 240. The corresponding 203 $\mathrm{dB}_{\mathrm{RMS}}$ level is considered a realistic and conservative value that aligns with the history of operations of the Dura-Spark 240 over three years of survey by Atlantic Shores. Operational information provided by Atlantic Shores. Geo Marine Survey System operating at 400 J.

[b] Gene Andella (Edgetech), personal conversation with JASCO Applied Sciences, 2019-07-29.

[c] Manufacturer specifications and/or correspondence with manufacturer.

[d] Considered EdgeTech Chirp as a proxy source for levels as the Chirp512i has similar operation settings as the Chirp 2000-DSS tow vehicle. See Table 18 in Crocker and Fratantonio (2016) for source levels for 100% power and 2–12 kHz.

Values from Crocker and Fratantonio (2016) for 100% power and comparable bandwidth.

[f] For frequency of 4 kHz

[g] Based on personal communication with Benjamin Laws, NOAA Fisheries (2022a and 2022b), NOAA Fisheries does not expect take from these parametric sub-bottom profilers due to their lower frequencies and extremely narrow beamwidth. Therefore, these sources were not considered in calculating the maximum r value for the ZOI calculation.

[h] The specification sheet indicates a peak source level of 247 dB re 1 μPa m (Jens Wunderlich, Innomar, personal communication, 7-18-2019). The average difference between the peak SPL source levels for sub-bottom profilers measured by Crocker and Fratantonio (2016) was 6 dB. We therefore estimate the SPL source level is 241 dB re 1 μPa m.

To determine the type of take that could result from the operation of the HRG survey equipment operating below 180 kHz throughout the survey period, Atlantic Shores followed the interim recommendations provided by NOAA Fisheries (2020) and the NOAA Fisheries HRG Level B Impact Distance Calculation spreadsheet (pers comm. Benjamin Laws, NOAA Fisheries, 2022c) to estimate the maximum horizontal distance to the Level B marine mammal acoustic harassment threshold for impulsive noise (160 $\text{dB}_{\text{RMS90\%}}$ re 1 µPa) based on equipment source specifications. Results of this assessment are provided in Table 2.

Table 4. Equipment considered and maximum distances to Level B 160 $\text{dB}_{\text{RMS90\%}}$ threshold by equipment type operating below 180 kHz.

HRG survey equipment (sub-bottom profiler)	Representative equipment type	Operating frequencies ranges (kHz)	Operational source level ranges (dB_{RMS})	Beamwidth ranges (degree)	Distance to Level B threshold (m)
Sparker	Applied Acoustics Dura-Spark 240	0.01 to 1.9	203	180	141
	Geo Marine Geo-Source	0.2 to 5	195	180	56
Chirp	Edgetech 2000-DSS	2 to 16	195	24	56
	Edgetech 216	2 to 16	179	17, 20, or 24	9
	Edgetech 424	4 to 24	180	71	10
	Edgetech 512i	0.7 to 12	179	80	9
	Pangeosubsea Sub-Bottom Imager™	4 to 12.5	190	120	32

INNOMAR sources are not expected to exceed the Level A or B threshold criteria

1.2.3. Cofferdam Installation and Removal Equipment

The export cables will transition from offshore to onshore using horizontal directional drilling (HDD), a trenchless installation method designed to avoid nearshore impacts as well as impacts directly along the shoreline. Offshore, each HDD path will originate or terminate in an excavated pit. To create an offshore excavated pit, a cofferdam will need to be constructed, and a backhoe dredge may be required to assist with the excavation. A cofferdam is constructed from sheet piles that creates an enclosed area that can then be dewatered using pumps to allow for the excavation of the HDD pit. The need for a cofferdam will depend on the results of marine surveys conducted near the landfall sites, the depth of burial, and the direction of the HDD. Following installation of the HDD conduit and export cable, the seabed would be restored and the cofferdam removed. If used, Atlantic Shores anticipates that the cofferdam will be approximately 98.4 ft by 26.2 ft (30 m by 8 m). A total of 8 cofferdams, four at each of the landfall sites, may be constructed and dismantled using vibratory driving of steel sheet piles. Further information regarding cofferdam installation and removal can be found in Appendix D.

1.2.4. Unexploded Ordnances (UXO)

A study of Munitions and Explosives of Concern (MEC) Hazard Assessment has been provided to BOEM under confidential cover as part of the COP (see Volume II, Appendix II-A). This study indicated that the likelihood of encountering MEC during construction is low. In the event that UXO are found during construction, Atlantic Shores will implement a mitigation strategy to avoid UXO. At this time, no UXO detonation is planned. Atlantic Shores is not currently requesting take of marine mammals due to proposed UXO detonation.

1.2.5. Vessel Usage

Offshore construction may require a number of different types of vessels, including heavy transport vessels, heavy lift vessels, tugboats and barges, jack-up vessels, cable laying vessels, crew transfer vessels, and service operation vessels. Offshore construction will be divided into different campaigns including foundation installation, scour protection installation, OSS installation, WTG installation, inter-array cable installation, inter-link cable installation (if needed), and export cable installation. While performing construction tasks, vessels may anchor, jack-up, or maintain their position using DP systems. DP systems use a continually adjusting propulsion system to keep the vessel steady in a single location. Jack-up vessels have legs that lower into the seabed and brace the vessel as it elevates above sea level, where it can safely perform operations in a stable, elevated position Foundation installation, HRG surveys, and cofferdam installation and removal will be conducted by various vessels operating from various ports during the five-year LOA period.

1.2.5.1. Foundation Installation

The Projects' monopiles or piled jacket components may be fabricated either in the U.S. or overseas and will be delivered either directly to the WTA or to a marshalling port for final assembly and staging. Depending on the location of fabrication and any subsequent staging activities, foundation components may be transported to the marshalling port or WTA by heavy transport vessels (HTVs), ocean-going barges, jack-up feeder vessels, or smaller feeder barges towed by local tugboats.

Monopile and jacket pin pile foundations will be installed using one or two jack-up vessels or heavy lift vessels (HLVs) using dynamic positioning (DP) or anchoring.

Atlantic Shores has not yet selected the specific vessels that will carry out foundation installation activities. For the purposes of this LOA request, representative vessel types are presented in Table 5 rather than specific vessels, and vessel speed is based on the typical range for each type of vessel. Examples of vessels that could be used for piled foundation installation are shown in Figure 3.

Table 5. Representative WTG foundation and OSS installation vessels.

Role	Vessel Type	Count	Approx. operational speed (knots)
Foundation Installation			
Foundation Installation	Bulk Carrier	1	10
	Medium heavy Lift Vessel	1	10
	Jack-Up Vessel	1	10
Bubble Curtain Support Vessel	Tugboat	1	10
Transport Barge	Barge	2-3	3-10
Towing Tugboat	Tugboat	2-6	3-10
Support Vessel	Service Operation Vessel	1	10
Crew Transfer and Noise Monitoring	CTV	1	29
OSS Installation			
OSS Installation	Large Heavy Lift Vessel	1	10
	Medium Heavy Lift Vessel	1	10
Bubble Curtain Support Vessel	Tugboat	1	10
Transport Barge	Barge	4	10
Towing Tugboat	Tugboat	4	10
Assistance Tugboat	Tugboat	2	10
Crew Transfer and Noise Monitoring	CTV	1	29
Scour Protection			
Scour Protection Installation	Fall Pipe Vessel	1	10
Dredging	Dredger	1	10
Cofferdam Installation and Removal			
Cofferdam installation and removal	Spread-Moored Barge	1	10
	DP Barge	1	10

This representative list of vessels is derived from the detailed vessel PDE provide in Volume I of the COP Section 4.10.

Pile Driving of a Monopile

Transition Piece Installation from a Jack-Up Vessel

Monopile Transport via Tugboat and Barge

Pile Driving of a Jacket Pile

Figure 3. Piled foundation transportation and installation. Source: Fig. 4.2-2 of Atlantic Shores Constructions and Operations Plan Volume I.

Atlantic Shores has identified several port facilities in New Jersey, New York, the Mid-Atlantic, and New England that may be used for major construction staging activities for the Projects (Figure 4). Atlantic Shores expects that the foundation installation activities will be predominantly staged from Atlantic City and the New Jersey Wind Port in New Jersey. There are three major haul-out sites along the New Jersey coast, located in Great Bay, Sandy Hook, and Barnegay Inlet (CWFNJ 2015). All vessels transiting to and from these ports to the WTA may transit through pinniped haul-out areas, BIAs for cetaceans and or through Seasonal Management Areas (SMAs) or Dynamic Management Areas (DMAs) for the North Atlantic Right Whale (NARW). Voluntary DMAs are established by NOAA Fisheries based on visual sightings of three or more North Atlantic right whales within 2-3 miles of each other outside of active SMAs. Mariners are encouraged to avoid these areas or reduce speeds to 10 knots or less while transiting through these areas. DMAs are announced to mariners through customary maritime communication media, which display any active DMAs, with the most recent designation first. Atlantic Shores reviewed the NOAA Fisheries-identified SAMs and DAMs with respect to the project facilities and potential construction port locations (Figure 5). Atlantic Shores will follow the marine mammal vessel strike avoidance measures detailed in Section 11.1.4, including adhering to any speed restrictions in NARW SMAs and Dynamic Management Areas (DMAs).

Table 6 provides preliminary estimates of the vessel round trips associated with the installation of piled foundations and OSSs. It is anticipated that these estimates will be refined as construction planning for the Projects progresses. As described further in Section 11, vessel strike avoidance procedures will be implemented that reduce the potential risk of Project-related vessel collisions with marine mammals. To minimize the potential for vessel interactions with marine mammals during vessel operations, Atlantic Shores will follow federal guidelines to avoid vessel interactions with whales and adhere to all NOAA-mandated SMAs or Dynamic Management Areas (DMAs). Environmental training will also be provided to all vessel personnel responsible for operation, navigation, or lookout on marine mammal siting, avoidance, and reporting procedures.

Table 6. Estimated vessel round trips associated with installation of foundations and offshore substations.

Port	Average Round Trips/Month
Atlantic City	19
New Jersey Wind Port	17
European Ports	1
Total	**37**

1. Vessel counts include installation of WTG foundations, OSS foundations and topsides, and scour protection.
2. For all activities including a tug and barge combination, each tug and barge combination is treated as one vessel making a trip since the tug and barge are connected.

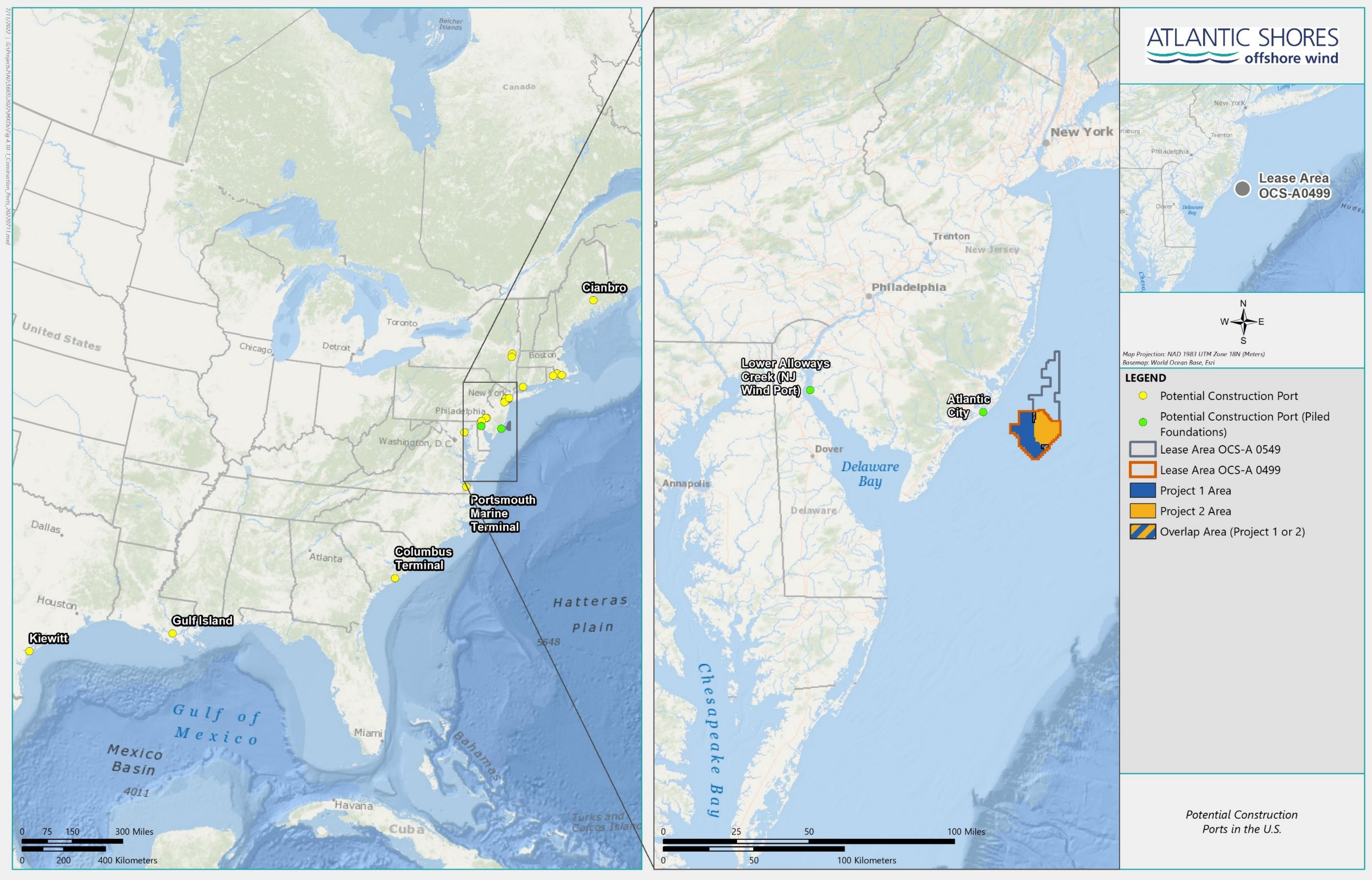

Figure 4. Port facilities that the Projects may use for major construction staging activities.

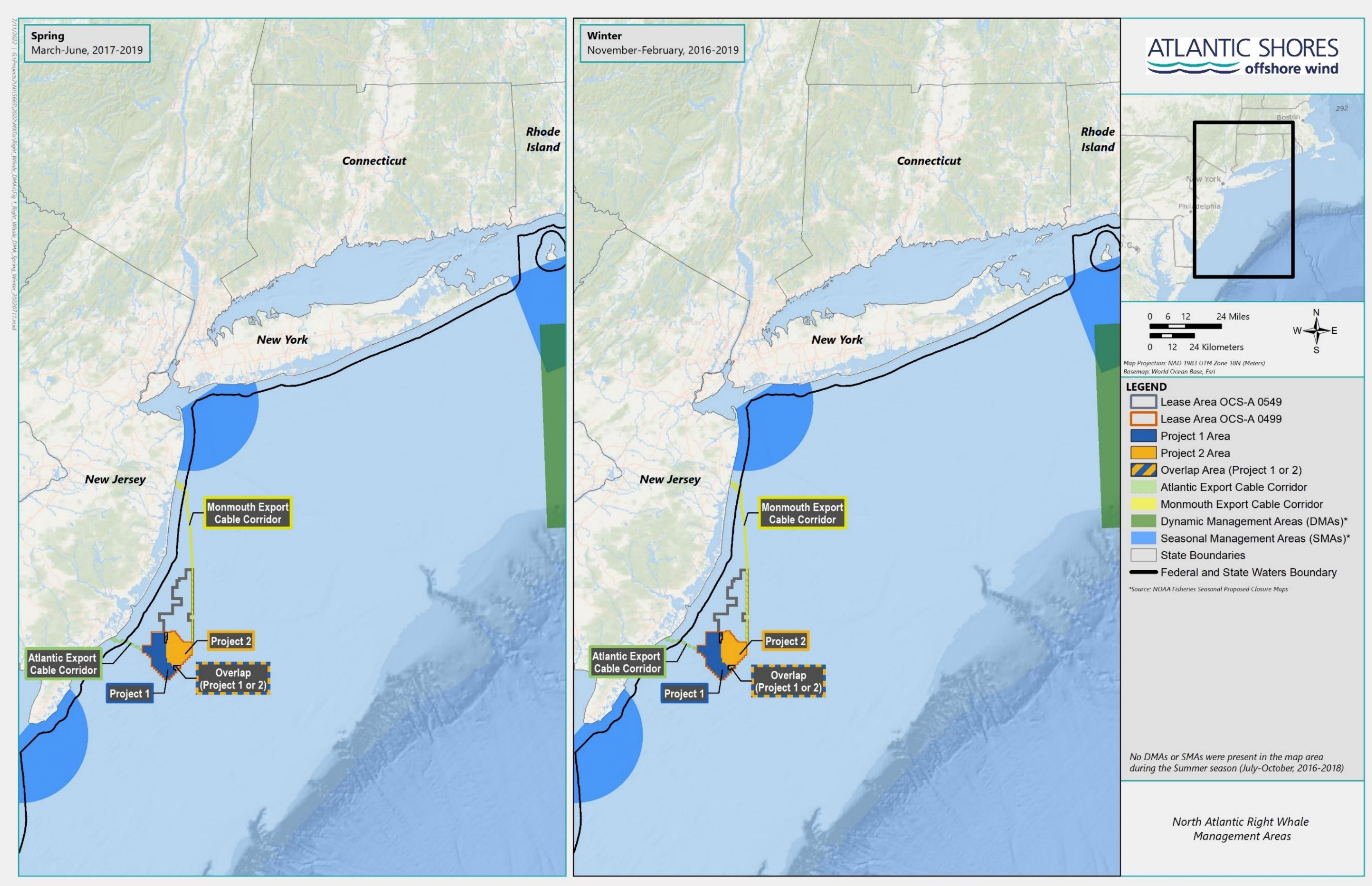

Figure 5. North Atlantic Right Whale Seasonal and Dynamic Management Areas in relation to Project facilities.

1.2.5.2. HRG Surveys

The HRG survey activities will be supported by vessels of sufficient size to accomplish the necessary pre- and post-construction survey goals. Depending on the type of survey required and the location of operation (e.g., nearshore vs offshore operations), survey equipment could be deployed from multiple vessels throughout the WTA and/or ECCs. Up to three geophysical vessels could be operating simultaneously in either the WTA or ECCs, typical operations would only include one vessel at a time. HRG survey vessels, will operate predominately out of Elizabeth or Atlantic City, NJ on three-week crew change rotations. HRG survey activities with the potential to result in the take of marine mammals will not occur within the WTA concurrent with pile driving.

1.2.5.3. Cofferdam Installation and Removal

Cofferdam installation will be supported by either spread-moored or dynamically positioned (DP) barges outfitted with the necessary equipment to perform the installation and removal activities. The specific vessels and equipment selected to perform the work will depend on the final design of the cofferdam and the availability of vessels and equipment.

1.3. High-Level Construction Schedule

Construction of each Project will initiate with the onshore facilities, including the onshore substations and/or converter stations and onshore interconnection cables. The onshore facilities for each Project will be constructed first so that power from the electrical grid can be used to energize, commission, and maintain each Project’s offshore facilities (e.g., the OSSs and WTGs) as soon as possible after their installation (see Table 7). Atlantic Shores anticipates that WTGs will become operational while remaining WTGs are being installed. This scenario is likely to occur between Projects 1 and 2 but is also expected to occur within the individual Projects. Cofferdam installation could occur anytime in 2025 of 2026 excluding summertime (approximately Memorial Day to Labor Day). Construction of the offshore facilities is expected to begin with installation of the export cables and the WTG and OSS foundations (including scour protection). Pile driving activity for foundation installation is expected to begin in approximately May 2026. Pile driving will not occur during the months of January through April to specifically minimize risk to NARW. Once the OSS foundations are installed, the topsides can be installed and commissioned, and the inter-link cables (if used) can be installed. At each WTG position, after the foundation is installed, the associated inter-array cables and WTGs can be installed. No concurrent piledriving is proposed. No HRG activity with the potential for take of marine mammals is planned within the WTA concurrent to pile driving activity. Installation of the Projects’ onshore and offshore facilities may occur over a period of up to 3 years (to accommodate weather and/or seasonal work restrictions); offshore construction is expected to last approximately 2 years with full operation of Project 1 starting in 2028 and Project 2 in 2029. Requested LOA start date is January 1, 2025. Requested LOA end date is December 31, 2029.

1.4. Activities Potentially Resulting in the Incidental Take of Marine Mammals

Atlantic Shores evaluated the entire range of construction activities within its PDE for their potential to result in acoustic harassment of marine mammals. Construction activities will include impact pile driving of

WTG and OSS foundations; HRG surveys; submarine cable installation; vibratory installation of cofferdams, topside installation of the WTGs, OSSs, and met tower; and met buoy deployment. Activities included in this request that could result in the incidental take of marine mammals are impact pile driving of monopile and jacket pin piles during foundation installation and HRG surveys. Impact pile driving could produce sounds that exceed the threshold criteria for Level A or Level B harassment. HRG surveys are not expected to exceed the Level A threshold criteria except at very close ranges from the source, therefore, only Level B take associated with HRG surveys is requested.

1.4.1. Impact Pile Driving

Piles deform when driven with 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 (Figure 6). Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the 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. Acoustic and animal movement modeling was conducted to estimate exposures above Level A and Level B thresholds from impact pile driving. Details are provided in Appendix A and methods and results are summarized in Section 6.

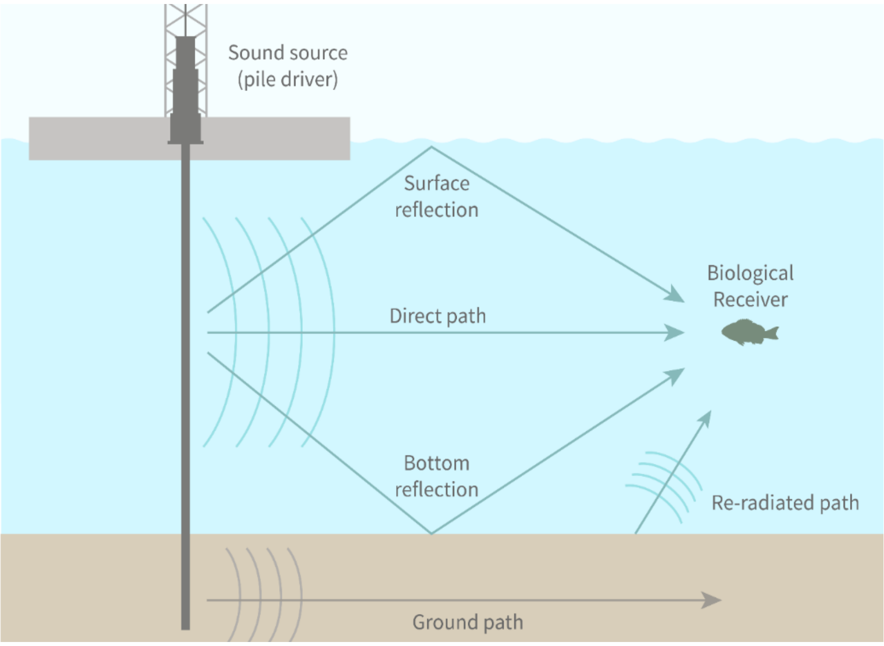

Figure 6. Sound propagation paths associated with pile driving (adapted from Buehler et al. 2015)

1.4.2. HRG Surveys

HRG survey equipment with operating frequencies below 180 kHz has the potential to produce sounds that exceed the acoustic threshold criterion for Level B harassment of marine mammals. Equipment potentially used in the HRG surveys was evaluated for its potential to result in harassment of marine mammals. Only sparker and chirp sub-bottom profilers were found to produce sounds that could exceed harassment thresholds. Details on the equipment and associated sound levels are provided in Section 1.2.2 and Appendix C.

1.4.3. Cofferdam Installation and Removal

Cofferdam installation and removal involves vibratory hammering of steel sheet piles, which has the potential to produce sounds that exceed the acoustic threshold criteria for non-impulsive sounds for Level A and Level B harassment of marine mammals. These sound levels were modeled by JASCO, and details of this modeling are provided in Section 6.2.5.2.

2. Dates, Duration, and Specified Geographic Regions

2.1. Dates of Construction Activities

For the purpose of this LOA request, three potential impact pile driving schedules were proposed and modeled to estimate marine mammal exposures to underwater sound from impact pile driving. Two of the pile driving schedules assumed foundation installation would require two years, and a third schedule assumed all foundations would be installed during one year. For all three schedules, foundation installation was assumed to initiate in May 2026 (see Table 7). To avoid and minimize impacts to NARW, a seasonal restriction from January through April has been applied to all foundation pile driving activity, during which time migratory NARW are most likely to be in the Offshore Project Area, thus limiting sound exposure for this endangered species.

HRG survey activity is planned to commence in the first year of foundation installation (assumed to be 2025 for the purpose of this LOA request, see Table 7) and to last for 5 years. Atlantic Shores estimates that a maximum of 60 days of HRG survey activity would occur per year. Survey is expected to occur in both the WTA and the ECCs each year. Atlantic Shores does not have an estimated annual breakdown of survey days split between the WTA and the ECCs at this time. No HRG activity with the potential for take of marine mammals is planned within the WTA concurrent to pile driving activity.

Cofferdam installation and removal activities are expected to occur in 2025 and/or 2026. As the exact schedule is unknown, it was assumed that all cofferdams would be installed and removed at the Atlantic City landfall site in 2025 (8 days of installation and 8 days of removal for a total of 16 days, see Table 7) and at the Monmouth landfall site in 2026 (8 days of installation and 8 days of removal for a total of 16 days). Atlantic Shores estimates installing four cofferdams during the September to May period at each site with a total of 32 days of vibratory hammering to account for both installation and removal. Cofferdam installation and removal will not occur concurrently with impact pile driving in the WTA.

Table 7. Calendar and LOA yearly breakdown for construction activities. Cells highlighted in blue indicate the years in which a construction activity occurs.

Calendar Year	2025	2026	2027	2028	2028
LOA Year	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Impact Pile Driving		🟦	🟦		
HRG Survey	🟦	🟦	🟦	🟦	🟦
Cofferdam	🟦	🟦			

2.2. Pile Driving Schedules

In assessing potential pile driving impacts, three construction schedules were modeled for each of three cases:

1. Full buildout of Project 1 and Project 2 as described in Section 1.2 (i.e., 200 WTGs, one met tower, and four large OSSs).
2. Buildout of Project 1 (105 WTG foundations, one met tower and two large OSSs) plus the Overlap Area (6 WTG foundations).
3. Buildout of Project 2 (89 WTG foundations and two large OSSs) plus the Overlap Area (6 WTG foundations).

Construction Schedules 1 and 2 are based on a 2-year buildout, and Construction Schedule 3 assumed a 1-year buildout. In all cases, the met tower was modeled to be installed on the same foundation type as the WTGs (201 total foundations).

Construction Schedule 1 assumed that the 201 foundations would all be monopiles and installed at a rate of one per day (201 days). Construction Schedule 2 assumed that the 201 foundations would be four-legged jacket foundations with one pin pile per leg (4 pin piles each for a total of 804 pin piles) and that pin piles would be installed at a rate of four per day (i.e., one four-legged jacket foundation per day which also equates to 201 days of piling). Construction Schedule 3 assumed that the 201 WTG and met tower foundations would all be monopiles, but, in this schedule, the monopile installation rate would be up to 2 per day (total of 201 foundations and 123 days).

For OSSs, all three construction schedules used in the modeling assumed that the maximum number of OSS, and the associated maximum number of piles (i.e. four large OSSs) would be installed, each on an eight-legged jacket foundation with 3 pin piles per leg (24 pin piles per OSS for a total of 96 pin piles) and that pin piles would be installed at a rate of four per day (6 days of piling per OSS). The construction schedules assumed that it would take 6 days to install all 24 pin piles for each large OSS. For Construction Schedules 1 and 2, Atlantic Shores assumed that one OSS foundation would be installed during June and August in each of the 2 years. Construction Schedule 3 assumed a 1-year full buildout, therefore, one OSS is installed per month during June through September. Although other OSS sizes are being considered, the modeling conservatively assumed four large OSSs as this represents the highest number of pin piles and the greatest number of piling days for the OSSs.

All three schedules assumed a pile installation schedule from May through December to avoid and minimize impacts to the NARW. No concurrent pile driving within the WTA was assumed. To be conservative, Construction Schedule 2 was used in calculating takes for this LOA request because it results in the highest number of estimated Level A and Level B takes due to the higher number of strikes required to drive the jacket pin piles and the longer piling time (see Appendix B). Detailed results of the modeling for all construction schedules are provided in Appendix B, but only results from the more conservative Construction Schedule 2 are provided below in the main body of this LOA request.

Tables 8–10 show Construction Schedule 2 for the three cases – full buildout, Project 1 plus Overlap, and Project 2 plus Overlap, respectively. As noted, Construction Schedule 2 was used in calculating takes for this LOA request as a conservative measure because it results in the highest number of estimated Level A and Level B takes. Therefore, only Construction Schedule 2 is shown here. All results in the main body of this LOA document use only Construction Schedule 2. For comparison, Schedules 1 and 3 are shown in Appendix A, and take estimates are provided in that appendix for Schedules 1 and 3 for the full project buildout (Appendix A.1) as well as for the Project 1 plus Overlap (Appendix A.2) and Project 2 plus Overlap (Appendix A.3) cases. Tables 8–10 show the number of days of pile driving (number of piles) during each month of the May through December construction period for these three cases under Construction Schedule 2.

Table 8. Atlantic Shores Construction Schedule 2 – Full Buildout: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 2: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)		Year 2 # Days (# Piles)		Total # Days (# Piles)[b]	
	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)
May	8 (32)	0 (0)	5 (20)	0 (0)	13	0 (0)
Jun	20 (80)	6 (24)	15 (60)	6 (24)	35	12 (48)
Jul	25 (100)	0 (0)	20 (80)	0 (0)	45	0 (0)
Aug	19 (76)	6 (24)	18 (72)	6 (24)	37	12 (48)
Sep	18 (72)	0 (0)	14 (56)	0 (0)	32	0 (0)
Oct	16 (64)	0 (0)	13 (52)	0 (0)	29	0 (0)
Nov	5 (20)	0 (0)	4 (16)	0 (0)	9	0 (0)
Dec	1 (4)	0 (0)	0	0 (0)	1	0 (0)
Total Piling Days	**112**	**12**	**89**	**12**	**201**	**24**
Total Piles	**448**	**48**	**356**	**48**	**804**[c]	**96**
Total Foundations	**112**	**2**	**89**	**2**	**201**	**4**

[a] The schedules assume a start year of 2026 for WTG foundation installation. Construction Schedule 2 is used in the take estimation.

[b] Modeling assumed 201 WTG foundations and 4 large OSSs.

[c] The PDE is inclusive of 200 WTG foundations and 1 Met tower on a WTG foundation.

Table 9. Atlantic Shores Construction Schedule 2 – Project 1 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 2: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)[b]		Year 2 # Days (# Piles)		Total # Days (# Piles)	
	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)
May	8 (32)	0 (0)	0 (0)	0 (0)	8 (32)	0 (0)
Jun	20 (80)	6 (24)	0 (0)	0 (0)	20 (80)	6 (24)
Jul	25 (100)	0 (0)	0 (0)	0 (0)	25 (100)	0 (0)
Aug	19 (76)	6 (24)	0 (0)	0 (0)	19 (76)	6 (24)
Sep	18 (72)	0 (0)	0 (0)	0 (0)	18 (72)	0 (0)
Oct	16 (64)	0 (0)	0 (0)	0 (0)	16 (64)	0 (0)
Nov[c]	5 (20)	0 (0)	0 (0)	0 (0)	5 (20)	0 (0)
Dec[c]	1 (4)	0 (0)	0 (0)	0 (0)	1 (4)	0 (0)
Total Piling Days	**112**	**12**	**0**	**0**	**112**	**12**
Total Piles	**448**	**48**	**0**	**0**	**448**	**48**
Total Foundations	**112**	**2**	**0**	**0**	**112**	**2**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. Construction Schedule 2 is used in the take request.

[b] Modeling assumed 106 WTG foundations (105 WTGs + 1 Met Tower) installed during May–October in the Project 1 Area plus an additional 6 WTG foundations installed during November–December in the Overlap Area as well as 2 large OSSs installed during June and August in the Project 1 Area. All foundation installation for Project 1 plus Overlap would occur during year 1.

[c] The 6 WTG foundations installed during November–December are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

Table 10. Atlantic Shores Construction Schedule 2 – Project 2 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 2: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)		Year 2 # Days (# Piles)		Total # Days (# Piles)[b]	
	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)	WTG Jacket 5 m (4 piles/d)	OSS Jacket 5 m (4 piles/d)
May	0 (0)	0 (0)	5 (20)	0 (0)	5 (20)	0 (0)
Jun	0 (0)	0 (0)	15 (60)	6 (24)	15 (60)	6 (24)
Jul	0 (0)	0 (0)	20 (80)	0 (0)	20 (80)	0 (0)
Aug	0 (0)	0 (0)	18 (72)	6 (24)	18 (72)	6 (24)
Sep	0 (0)	0 (0)	14 (56)	0 (0)	14 (56)	0 (0)
Oct	0 (0)	0 (0)	13 (52)	0 (0)	13 (52)	0 (0)
Nov	5 (20)	0 (0)	4 (16)	0 (0)	9 (36)	0 (0)
Dec	1 (4)	0 (0)	0	0 (0)	1 (4)	0 (0)
Total Piling Days	**6**	**0**	**89**	**12**	**95**	**12**
Total Piles	**24**	**0**	**356**	**48**	**380**	**48**
Total Foundations	**6**	**0**	**89**	**2**	**95**	**2**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. Construction Schedule 2 is used in the take request.

[b] Modeling assumed 6 WTG foundations installed during November–December of year 1 in the Overlap Area as well as 89 WTG foundations installed during May–December of year 2 plus two large OSSs installed during June and August of year 2 in the Project 2 Area.

[c] The 6 WTG foundations installed during November–December of year 1 are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

2.3. Specific Geographical Region of Activity

Atlantic Shores' Offshore Project Area is located in the mid-Atlantic on the OCS. The Projects will be located within the approximate 102,124-acre (413.3-km^2) WTA located within Lease Area OCS-A 0499 approximately 8.7 mi (14 km) from the New Jersey shoreline (see Figure 1). Project 1 is located in the western 54,175 acres (219.2 km^2) of the WTA, and Project 2 is located in the eastern 45,013 acres (182.2 km^2) of the WTA, with a 2,936-acre (11.9-km^2) Overlap Area that could be used by either Project 1 or Project 2. The WTA is located directly south of and adjacent to Lease Area OCS-A 0549 which was formally segregated from Lease Area OCS-A 0499 in April 2022.

HRG surveys will occur within the approximately 589,511- acre survey area. The Survey Area extends from the coastline out to a maximum distance of approximately 24 nautical miles (nm) and generally spans from Wall Township, New Jersey to Atlantic City, New Jersey (Figure 7).

Cofferdam installation and removal will occur as part of the export cable landing at the two cable landing sites. Four cofferdams (see Figure 1 of Appendix D) may be constructed at each of the Atlantic ECC and Monmouth ECC landfall locations.

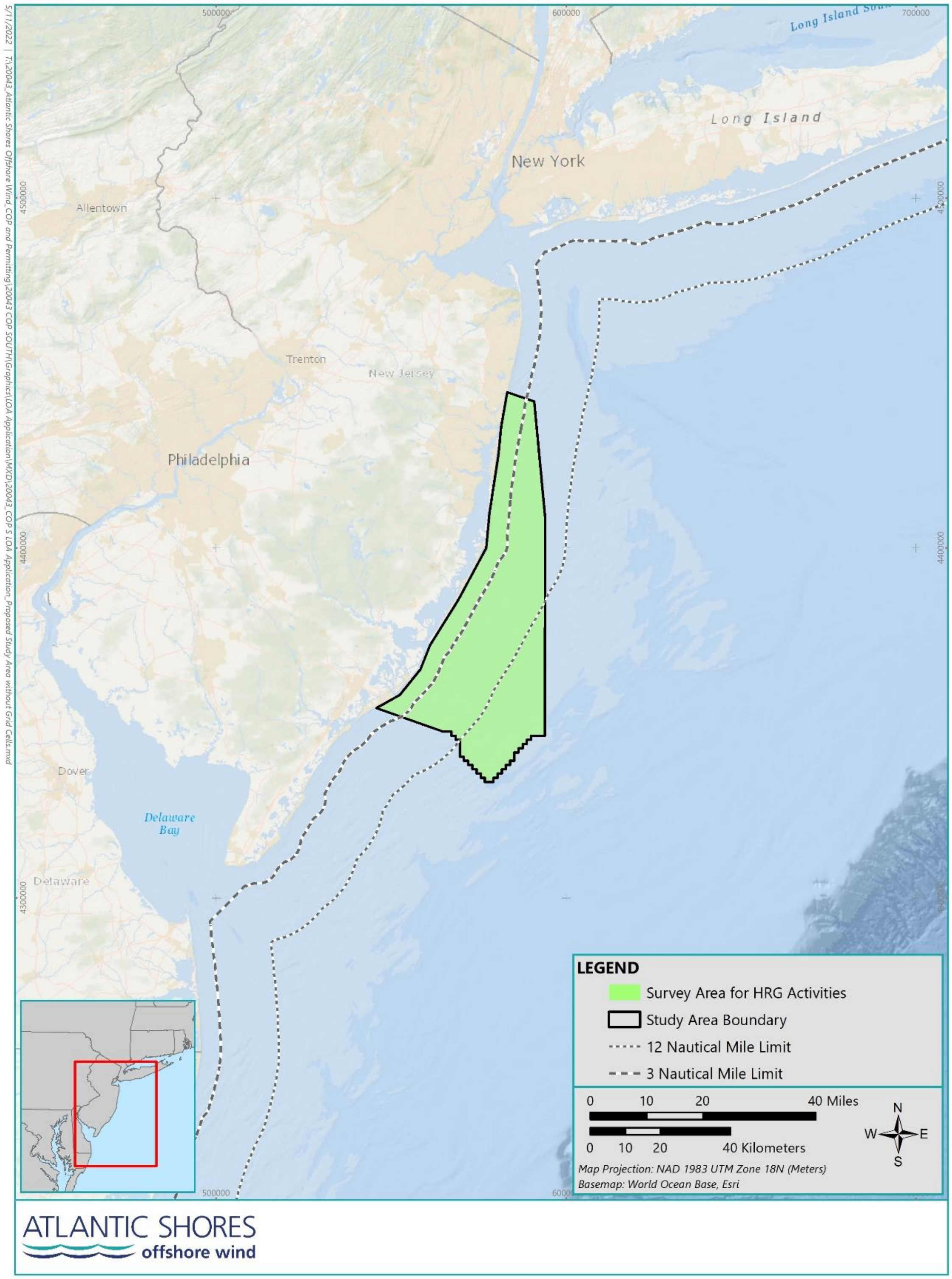

Figure 7. Proposed HRG survey area.

3. Species and Number of Marine Mammals

The marine mammal species that occur in the Offshore Project Area during construction may experience certain effects from Project activities. Descriptions of the marine mammal species, their distribution and abundance, and estimated densities in the vicinity of the Offshore Project Area are based on reviews of existing technical reports, academic publications, and public reports (e.g., press releases), where relevant, to describe recent events not yet published. Examples of primary data sources referenced in this assessment include the following:

- Marine Mammal Stock Assessment Reports

  The National Marine Fisheries Service (NMFS) releases Stock Assessment Reports (SARs) for marine mammals that occur within the U.S. Atlantic Exclusive Economic Zone (EEZ) as required under the 1994 amendments to the Marine Mammal Protection Act (MMPA). All stocks are reviewed at least every three years or as new information becomes available. Stocks that are designated as strategic are reviewed annually. Each report contains a description of a stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, an estimate of the potential biological removal (i.e. maximum number of animals that may be removed from a marine mammal stock without reducing numbers below the optimum sustainable population) for each species, the status of the stock, estimates of annual human-caused mortality and serious injury by source, and descriptions of other factors that may be causing a decline or impeding the recovery of strategic stocks (NOAA Fisheries 2021b)

- Ocean Wind Power Ecological Baseline Studies conducted for the New Jersey Department of Environmental Protection Office of Science by the Geo-Marine, Inc.

  This Ecological Baseline Study includes the first year-round, systematic survey effort in nearshore waters of New Jersey between Stone Harbor and Seaside Park. The objective of this study was to determine the spatial distribution and to estimate the abundance/density of marine mammals and sea turtles in the Study Area (shoreline to around 37 km [20 nm] offshore). This baseline study was conducted over a 24-month period between January 2008 and December 2009. The three sampling techniques conducted during this study included aerial line transect surveys, shipboard line transect surveys, and passive acoustic monitoring (PAM) (Geo-Marine 2010).

- Atlantic Marine Assessment Program for Protected Species (AMAPPS)

  The AMAPPS Phase I surveys were conducted from 2010–2014 (NEFSC and SEFSC 2011, 2012, 2014a, 2014b), and Phase II surveys from 2015–2020 (NEFSC and SEFSC 2015, 2016, 2018, 2019, 2020). Phase III will acquire data through 2023. AMAPPS surveys include aerial and shipboard observations, biological and oceanographic sampling, satellite-telemetry, and PAM conducted in all four seasons of the year. AMAPPS reports provide updated information on the abundance and distribution of marine mammals, sea turtles, and sea birds and assess recent changes in seasonal habitat use by these species. These data can be used to quantify changing species' abundance and distributions and assess the potential impact of human activities on protected species. The abundance estimates used by NMFS for many of the marine mammal species within the U.S. Atlantic EEZ are based on the AMAPPS surveys (NOAA Fisheries 2020a).

- Duke University Habitat-based Marine Mammal Density Models for the U.S. Atlantic

  The Duke University habitat-based density models were originally published in 2016 for 26 cetacean species and three cetacean species' guilds for U.S. waters of the North Atlantic and northern Gulf of Mexico (Roberts et al. 2016a). Under an ongoing research agreement with the U.S. Navy, the models were subsequently updated for the Atlantic (the East Coast [EC] models) using the same methods but incorporating additional data, including NOAA Fisheries' AMAPPS surveys, NARW Early Warning System surveys, and other data (Roberts et al. 2016b). Later revisions to the EC models under this research agreement included updates to 11 cetacean taxa in 2017 and an additional 10 cetacean taxa in 2018 (Roberts et al. 2017, 2018). The 2018 update also included the addition of seals as a guild (Roberts et al. 2018). More recent updates have focused on the NARW, including the latest revision of this species' density in February 2021 and addition of uncertainty to the density estimation in November 2021. The animal modeling undertaken in support of this LOA request used this most recent EC model versions, including the NARW v11.1 update[6].

In addition to these sources of information, Atlantic Shores is conducting aerial digital surveys of the Offshore Project Area. Started in 2020, these surveys are complete. The results of these surveys and a detailed technical report were provided in the 2021 COP supplement. Atlantic Shores has also completed an underwater acoustic and animal exposure modeling analysis for impact pile-driving sound based on the maximum PDE. The complete, Underwater Acoustic and Animal Exposure Modeling Technical Report (Modeling Report) is provided as Appendix II-L to the COP and as Appendix A to this LOA request.

There are 38 marine mammal species, comprising 39 stocks, that are known to be present either seasonally or year-round in the Northwest Atlantic Outer Continental Shelf (OCS, Table 11). Marine mammals present in this region are represented by the Cetacea order, which includes six mysticetes (baleen whales) and 28 odontocetes (toothed whales, dolphins, and porpoise), and the Pinnipedia order, which includes four species of phocids (earless seals). Baleen whales migrate seasonally between cold high-latitude feeding grounds in summer and warm low-latitude breeding/nursery grounds in winter, rarely spending extended time in a single area. Odontocetes, or toothed whales, occupy coastal, shelf, and slope/deep water habitats inclusive, and further offshore, of the Mid-Atlantic Bight. Most toothed whale species do not undergo long-range seasonal migrations, instead moving between southern and northern waters of the western North Atlantic or between shelf waters and deeper waters beyond the shelf break within a relatively regionalized area (Hayes et al. 2020). Phocid species of the western North Atlantic primarily occupy coastal and shelf habitats in the cooler waters north of Cape Cod, Massachusetts to eastern Canada and Maine throughout the year (Hayes et al. 2020).

Table 11 provides a list of the marine mammal species present in the OCS and their relative occurrence in the Project Area. Species categories for relative occurrence include:

- Common - Occurring consistently in moderate to large numbers.
- Regular - Occurring in low to moderate numbers on a regular basis or seasonally.
- Uncommon - Occurring in low numbers or on an irregular basis.
- Rare - There are limited species records for some years; range includes the Mid-Atlantic Bight but due to habitat preferences and distribution information, species are not expected to occur in the Mid-Atlantic Bight.

The protection status, stock identification, occurrence, and abundance estimate of the species listed in Table 11 and categorized as common, regular, and uncommon, are discussed in more detail. Uncommon species for the Offshore Project Area include sperm whales (*Physeter macrocephalus*), Risso's dolphins (*Grampus griseus*), pilot whales (*Globicephala* spp.), and Atlantic white-sided dolphins (*Lagenorhynchus acutus*). There were no sperm whales, Risso's dolphins, pilot whales, or Atlantic white-sided dolphin sightings during the New Jersey Ecological Baseline Studies conducted by Geo-Marine (2010); however, these species are discussed in this section because they are expected to be potential seasonal visitors off

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[6] Downloaded in 2021 from the model home page: https://seamap.env.duke.edu/models/Duke/EC/.

New Jersey based on historic occurrence data (Roberts et al. 2018). Species listed as rare are not considered further in this assessment.

Table 11. Marine mammal species potentially occurring within the Atlantic Shores Offshore Wind Projects Lease Area. Species listed as rare are not considered further in this assessment.

Species	Scientific name	Stock	Regulatory Status [a]	Project Area occurrence	Abundance [b]	Modeled species?
BALEEN WHALES (Mysticeti)						
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered	Rare	402	N
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered	Common	6,802	Y
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	MMPA	Common	1,396	Y
Minke whale	*Balaenoptera acutorostrata*	Canadian Eastern Coastal	MMPA	Common	21,968	Y
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered	Common	368[c]	Y
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered	Common	6,292	Y
TOOTHED WHALES (Odontoceti)						
Sperm whales (Physeteridae)						
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered	Uncommon	4,349	Y
Dolphin family (Delphinidae)						
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	MMPA	Uncommon	39,921	Y
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	MMPA	Common	93,233	Y
Bottlenose dolphin[d]	*Tursiops truncatus*	Western North Atlantic, offshore	MMPA	Common	62,851	Y
		Western North Atlantic, Northern Migratory Coastal	MMPA Depleted and Strategic	Common	6,639	Y
Clymene dolphin	*Stenella clymene*	Western North Atlantic	MMPA	Rare	4,237	N
False killer whale	*Pseudorca crassidens*	Western North Atlantic	MMPA	Rare	1,791	N
Fraser’s dolphin	*Lagenodelphis hosei*	Western North Atlantic	MMPA	Rare	Unknown	N
Killer whale	*Orcinus orca*	Western North Atlantic	MMPA	Rare	Unknown	N
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	MMPA	Rare	Unknown	N
Pan-tropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	MMPA	Rare	6,593	N
Pilot whale, long-finned	*Globicephala melas*	Western North Atlantic	MMPA	Uncommon	39,215	Y
Pilot whale, short-finned	*Globicephala macrorhynchus*	Western North Atlantic	MMPA	Uncommon	28,924	Y
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	MMPA	Rare	Unknown	N

Species	Scientific name	Stock	Regulatory Status [a]	Project Area occurrence	Abundance [b]	Modeled species?
Risso's dolphin	*Grampus griseus*	Western North Atlantic	MMPA	Uncommon	35,215	Y
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	MMPA	Rare	136	N
Short-beaked common dolphin	*Delphinus delphis*	Western North Atlantic	MMPA	Common	172,974	Y
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	MMPA	Rare	4,102	N
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	MMPA	Rare	67,036	N
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	MMPA	Rare	536,016	N
Beaked whales (Ziphiidae)						
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	MMPA	Rare	5,744	N
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic	MMPA	Rare	10,107[e]	N
Gervais' beaked whale	*Mesoplodon europaeus*	Western North Atlantic	MMPA			N
Sowerby's beaked whale	*Mesoplodon bidens*	Western North Atlantic	MMPA			N
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic	MMPA			N
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	MMPA	Rare	Unknown	N
Dwarf and pygmy sperm whales (Kogiidae)						
Dwarf sperm whale	*Kogia sima*	West North Atlantic	MMPA	Rare	7,750[f]	N
Pygmy sperm whale	*Kogia breviceps*	West North Atlantic	MMPA	Rare	7,750[f]	N
Porpoises (Phocoenidae)						
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/ Bay of Fundy	MMPA	Common	95,543	Y
Seals (Pinnipedia)						
Gray seal	*Halichoerus grypus*	Western North Atlantic	MMPA	Common	27,300[g]	Y
Harbor seal	*Phoca vitulina*	Western North Atlantic	MMPA	Regular	61,336	Y
Harp seal	*Pagophilus groenlandicus*	Western North Atlantic	MMPA	Rare	Unknown[h]	N
Hooded seal	*Cystophora cristata*	Western North Atlantic	MMPA	Rare	Unknown	N

[a] Denotes the highest federal regulatory classification. A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal level; 2) that is declining and likely to be listed as threatened under the Endangered Species Act (ESA); or 3) that is listed as threatened or endangered under the ESA or as depleted under the MMPA (NOAA Fisheries 2019).

[b] Best available abundance estimate is from NOAA Fisheries Stock Assessment Reports (NOAA Fisheries 2021b).

[c] Best available abundance estimate is from NOAA Fisheries Stock Assessment Report (NOAA Fisheries 2021b). NARW consortium has released the 2021 report card results predicting a NARW population of 336 for 2020 (Pettis et al. 2022). However, the consortium "alters" the methods of Pace et al. (2017) to subtract additional mortality. This method is used in order to estimate all mortality, not just the observed mortality, therefore the 2021 draft SAR (NOAA Fisheries 2021b) will be used to report an unaltered output of the (Pace et al. 2017, 2021) model (DoC and NOAA 2020).

[d] Bottlenose dolphins occurring in the Project Area could belong to the either the Western North Atlantic Offshore stock or the Western North Atlantic Coastal Migratory stock.

[e] This estimate includes all undifferentiated Mesoplodon spp. beaked whales in the Atlantic. Sources: Kenney and Vigness-Raposa (2009), Rhode Island Ocean Special Area Management Plan (2011), Waring et al. (2011, 2013, 2015), Hayes et al. (2017, 2018, 2019, 2020)

[f] This estimate includes both dwarf and pygmy sperm whales. Source: NOAA Fisheries (2021b).

[g] Estimate of gray seal population in U.S. waters. Data are derived from pup production estimates; Hayes et al. (2019, 2020, 2021) notes that uncertainty about the relationship between whelping areas along with a lack of reproductive and mortality data make it difficult to reliably assess the population trend.

[h] NOAA Fisheries (2021b) report insufficient data to estimate the population size of harp seals in U.S. waters; the best estimate for the whole population is 7.6 million.

4. Affected Species Status and Distribution

There are 16 marine mammal species from 17 stocks that are Endangered, strategic, and/or can be reasonably expected to reside, traverse, or visit the Offshore Project Area, and thus may experience some level of exposure to sound from Projects' pile driving activities. These species were modeled (see Section 6.2.5 and Appendix A) in order to estimate the amount of Project species' exposures for the purposes of a take request. However, species that are listed as rare within Table 11 are considered extralimital to the area and are not assessed in this LOA request. The North Atlantic right whale (NARW), fin whale, sei whale, and sperm whale are all considered Endangered under the Endangered Species Act (ESA). These four species are also considered strategic under the MMPA, and their seasonal density figures are provided in their respective subsections.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and existing threats to the non-ESA-listed and ESA-listed marine mammal species that are either common, regular, or uncommon in Mid-Atlantic Bight waters (i.e., have the likelihood of occurring at least seasonally), and therefore in the Offshore Project Area. These species include the NARW, humpback whale, fin whale, sei whale, minke whale, bottlenose dolphin, short- and long-finned pilot whales, Risso's dolphin, short-beaked common dolphin, sperm whale, Atlantic white-sided dolphin, Atlantic spotted dolphin, harbor porpoise, gray seal, and harbor seal (BOEM 2014). Beaked whales are likely to occur in regions farther offshore along the continental shelf-edge but not within 40 nm (74 km) of shore (Hayes et al. 2020). While the potential for interactions with sperm whales, pilot whales, Atlantic white-sided dolphins, and Risso's dolphins is low, small numbers of these species may transit the Offshore Project Area and are therefore included in this analysis. In general, the remaining non-ESA mammal species listed in Table 11 range outside the Offshore Project Area, usually in deeper water, or are so rarely sighted that their presence is unlikely, and they are therefore not further considered in this LOA request.

4.1. Mysticetes

4.1.1. Fin Whale (*Balaenoptera physalus*)

Fin whales are the second largest species of baleen whale that occur in the northern hemisphere, with a maximum length of about 75 feet (ft) (22.8 m) (NOAA Fisheries 2018l). These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. Fin whales have a distinctive coloration pattern: the dorsal and lateral sides of their bodies are black or dark brownish-gray while the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (*Euphausiacea*), small schooling fish (e.g., herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [*Ammodytidae* spp.]), and squid (*Teuthida* spp.) by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010). Fin whales are low-frequency cetaceans producing short duration down sweep calls between 15 and 30 hertz (Hz), typically termed "20-Hz pulses", as well as other signals up to 1 kilohertz (kHz) (Southall et al. 2019). The sound level of fin whale vocalizations can reach 186 decibels (dB) re 1 µPa, making them one of the most powerful biological sounds in the ocean (Charif et al. 2002).

4.1.1.1. Distribution

Fin whales found offshore U.S. Atlantic, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission management scheme (Donovan 1991), which has been named the Western North Atlantic stock. The current understanding of stock boundaries, however, remains uncertain (Hayes et al. 2019). The range of fin whales in the western North Atlantic extends from the Gulf of Mexico and Caribbean Sea to the southeastern coast of Newfoundland. Fin whales are common in waters of the U.S. Atlantic EEZ, principally from Cape Hatteras northward. There is evidence that fin whales are present year-round throughout much of the U.S. EEZ north of 35° N, but the density of individuals in any one area changes seasonally (NOAA Fisheries 2018l, Hayes et al. 2019). Fin whales are the most commonly observed large whales in continental shelf waters from the Mid-Atlantic coast of the U.S. to Nova Scotia (Sergeant 1977, Sutcliffe and Brodie 1977, CeTAP 1982, Hain et al. 1992), and were the most common baleen whale species detected in an ecological baseline survey conducted in coastal New Jersey waters, which surveyed an area that encompassed 97% of the New Jersey Wind Energy Area (Geo-Marine 2010, BOEM 2012). Fin whales are the dominant large cetacean species during all seasons from Cape Hatteras to Nova Scotia, having the largest standing stock, the largest food requirements, and, therefore, the largest influence on ecosystem processes of any baleen whale species (Hain et al. 1992, Kenney et al. 1997).

Fin whales have a high multi-seasonal relative abundance in U.S. Mid-Atlantic waters, and surrounding areas (Figure 8). During the Geo-Marine (2010) survey, most of the sightings were observed during winter and summer. Within the study area, group size ranged from one to four animals with a mean distance from shore of 20 km and a mean water depth of 21.5 m (Geo-Marine 2010). One calf was observed with an adult fin whale in the area (Geo-Marine 2010). There were mixed aggregations of feeding humpbacks during fin whale sightings, and with the presence of known prey species, it is possible that fin whales use this area to feed (Geo-Marine 2010). Acoustic data also indicate that this species is present in the area in all seasons (CETAP 1982). Fin whales were the most common marine mammal species detected acoustically during the study (Geo-Marine 2010).

While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, their mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992, Hayes et al. 2019). Acoustic detections of fin whale singers augment and confirm these visual sighting conclusions for males. Recordings from Massachusetts Bay, New York Bight, and deep-ocean areas have detected some level of fin whale singing from September through June (Watkins et al. 1987, Clark and Gagnon 2002, Morano et al. 2012). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the western North Atlantic for most of the year (Hayes et al. 2019). It is likely that fin whales occurring within the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions; however, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support (Hayes et al. 2019). Based on an analysis of neonate stranding data, Hain et al. (1992) suggest that calving occurs during October to January in latitudes of the U.S. Mid-Atlantic region.

Low-frequency vocalizing fin whale pulses were detected in the northern and eastern range of the study area where shelf waters are typically deeper (Geo-Marine 2010). Fin whales were acoustically detected on 281 days from March 2008 to October 2009 and documented in every month of acoustic recording indicating a lack of seasonal trends (Geo-Marine 2010). As the detection range for fin whale vocalizations is more than 108 nm (200 km), detected signals may have originated from areas far outside of the study area; however, the acoustic presence suggest that this species can be found regularly along the New Jersey outer continental shelf (Geo-Marine 2010).

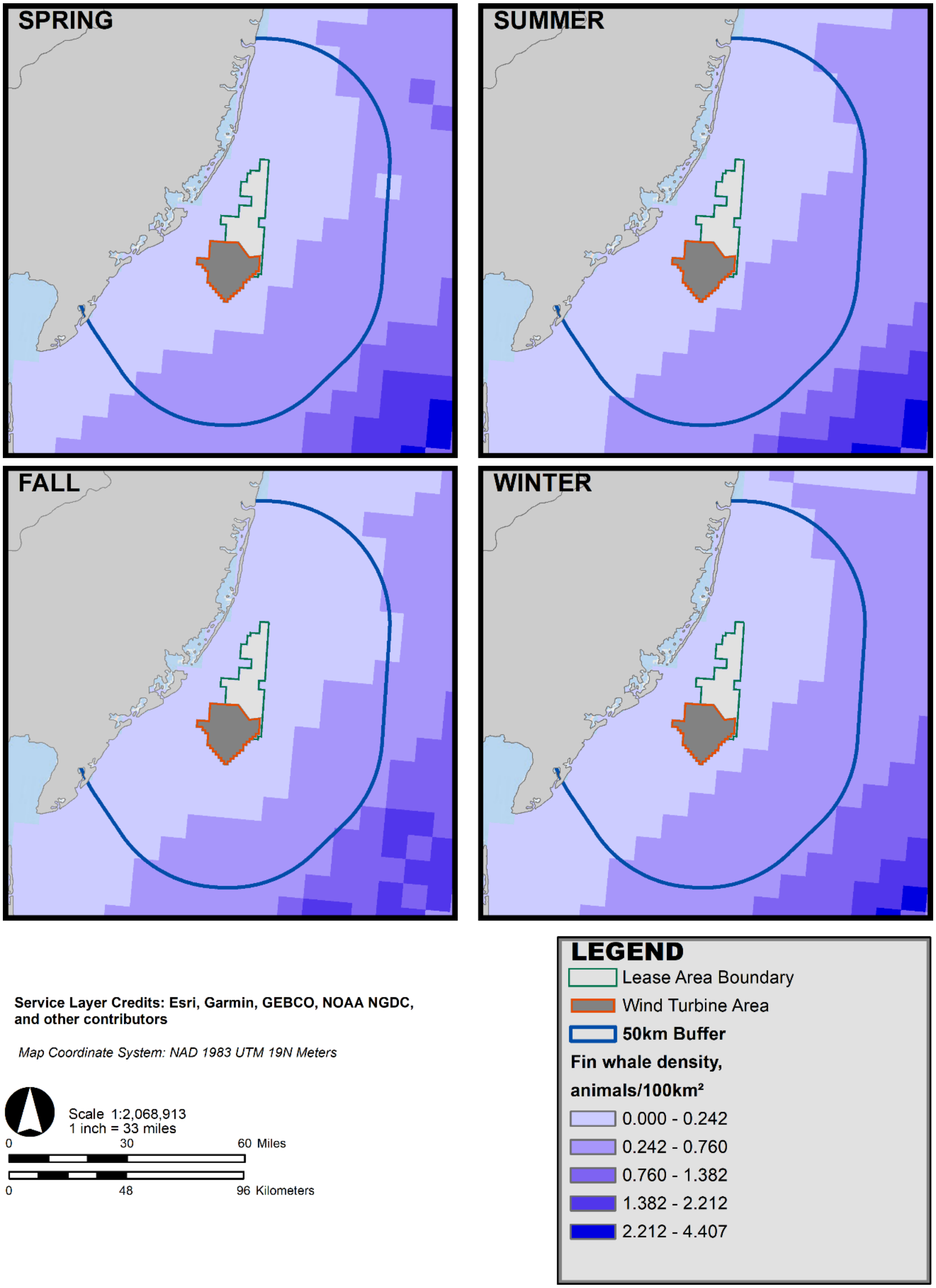


Figure 8. Fin whale maximum seasonal density from Roberts et al. (2016a, 2018).

4.1.1.2. Abundance

The best available abundance estimate for the Western North Atlantic fin whale stock in U.S. waters from NMFS stock assessments is 6,802 individuals (Hayes et al. 2021). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and variable survey design (Hayes et al. 2021).

4.1.1.3. Status

The fin whale is federally listed under the ESA as an Endangered marine mammal and are designated as a strategic stock under the MMPA due to their Endangered status, uncertain human-caused mortality, and incomplete survey coverage of the stock's defined range.

4.1.2. Humpback Whale (*Megaptera novaeangliae)*

Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. This baleen whale species feeds 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 lunge feeding, bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NMFS 1991). Humpback whale females are larger than males and can reach lengths of up to 59 ft (18 m) (NOAA Fisheries 2018b), and reach sexual maturity between the ages four and ten with females producing a single calf every two to three years.

Humpback whales are low-frequency cetaceans but have one of the most varied vocal repertoires of the baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic "song". Songs are variable but typically occupy frequency bands between 300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham 2004, Vu et al. 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, low-frequency pulses (with sound levels up to 176 dB re 1 μPa) between 25 and 90 Hz (Clark and Clapham 2004, Vu et al. 2012).

4.1.2.1. Distribution

Humpback whales are a cosmopolitan species and widely distributed in the Western Atlantic. Most humpback whales that inhabit the waters within the U.S. Atlantic EEZ belong to the Gulf of Maine stock, formerly called the Western North Atlantic Stock. Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but they have been observed feeding in other areas, such as off the coast of New York (Sieswerda et al. 2015). Humpback whales from most feeding areas, including the Gulf of Maine, migrate to the West Indies (including the Antilles, Dominican Republic, Virgin Islands, and Puerto Rico) in winter, where they mate and calve their young (Katona and Beard 1990, Palsbøll et al. 1997). There have been several wintertime humpback sightings in coastal waters of the eastern U.S., including 46 sightings of humpbacks in the New York-New Jersey Harbor Estuary documented between 2011 and 2016 (Brown et al. 2017). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies every winter because significant numbers of animals are observed in mid- and high-latitude regions at this time (Swingle et al. 1993).

Humpback whales are known to occur regularly throughout the Mid-Atlantic Bight, including New Jersey waters (Geo-Marine 2010). The occurrence of this population is strongly seasonal with most observations occurring during the spring and fall, with a peak from April to June (Geo-Marine 2010, Curtice et al. 2019). There have also been documented strandings from the New Jersey coast (Barco et al. 2002). Geo-Marine (2010) observed humpback whales during all seasons including seven observations in the winter. Group size tended to be single animals or pairs with a mean distance from shore of 11.4 mi (18.4 km) and a mean depth of 67 ft (20.5 m) (Geo-Marine 2010). Acoustic data indicate that this species may be present within the surrounding areas year-round, with the highest rates of acoustic detections in adjacent waters in winter and spring (Kraus et al. 2016). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. Humpback whales have previously been observed feeding off the coast of New Jersey with juveniles exhibiting feeding behavior just south of the study area near the mouth of the Chesapeake Bay (Swingle et al. 1993). There was one instance of observed lunge-feeding on effort within the study area (Geo-Marine 2010). Additionally, a cow-calf pair was seen once north of the study area boundary suggesting that the nearshore waters off of New Jersey may provide important feeding and nursery habitats for humpback whales (Geo-Marine 2010).

4.1.2.2. Abundance

The Gulf of Maine humpback whale stock consists of approximately 1,396 whales and is characterized by a positive trend in abundance with a maximum annual production rate estimate of 6.5% (Barlow and Clapham 1997, Hayes et al. 2020). The most significant anthropogenic causes of mortality to humpback whales remain incidental fishery entanglements, responsible for roughly eight whale mortalities, while vessel collisions are responsible for four mortalities, both on average annually from 2013–2017 (Hayes et al. 2020).

4.1.2.3. Status

The entire humpback whale species was previously listed as Endangered under the ESA. However, in September 2016, NOAA Fisheries identified 14 Distinct Population Segments (DPSs) of humpback whales and revised the ESA listing for this species (DoC 2016a). Four DPSs were listed as Endangered, one as Threatened, and the remaining nine DPSs were deemed not warranted for listing. Humpback whales in the U.S. Atlantic EEZ belong to the West Indies DPS, which is considered not warranted for listing under the ESA (DoC 2016a). The Gulf of Maine stock is not considered depleted because it does not coincide with any ESA-listed DPS. Humpback whales in the western North Atlantic have been experiencing an Unusual Mortality Event (UME) since January 2016 that appears to be related to a larger than usual number of vessel collisions (NOAA Fisheries 2018c). In total, 88 strandings were documented between 2016 and 2018 (Hayes et al. 2020). This most recent UME is ongoing. A biologically important area (BIA) for humpback whales for feeding from March to December has been designated in the Gulf of Maine, Stellwagen Bank, and the Great South Channel; all of which are north of the WTA (LaBrecque et al. 2015).

4.1.3. Minke Whale (*Balaenoptera acutorostrata)*

Minke whales are a small baleen whale species reaching 33 ft (10 m) in length (NOAA Fisheries 2018d). This species has a dark gray-to-black back and a white ventral surface (NOAA Fisheries 2018d). 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 (NOAA Fisheries 2018d). Like other baleen whales, minke whales use low-frequency sounds to communicate with one another and to locate prey. They are believed to make mechanical sound calls and a variety of grunts, moans, and belches (Gedamke 2004).

4.1.3.1. Distribution

This species has a cosmopolitan distribution in temperate, tropical, and high latitude waters (Hayes et al. 2018). Common and widely distributed within the U.S. Atlantic EEZ, these whales are the third most abundant great whale (any of the larger marine mammals of the order Cetacea) within the U.S. Atlantic EEZ (CeTAP 1982). Until better information is available, minke whales within the U.S. Atlantic EEZ are considered part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45° W) to the Gulf of Mexico. It is uncertain if separate sub-stocks exist within the Canadian East Coast stock. Like many of the other pelagic baleen whales, minke whales conduct seasonal migrations between high latitude summer feeding waters and low latitude winter breeding and calving grounds. Acoustic monitoring surveys indicate minke whales leave wintering grounds for their northern migrations from March through April and move south once again in mid-October through November (Risch et al. 2014).

Although primarily documented near the continental shelf offshore of New Jersey (Schwartz 1962, Mead 1975, Potter 1979, Rowlett 1980, Potter 1984, Winn et al. 1985, DoN 2005), minke whales have been sighted nearshore at water depths of 36 ft (11 m) (Geo-Marine 2010). Acoustic recordings of minke whales have been detected north of the WTA within the New York Bight during the fall (August to December) and winter (February to May) (Biedron et al. 2009). A juvenile minke whale was sighted north of the WTA near the New York Harbor in April, 2007 (Hamazaki 2002). The expected occurrence of minke whales near the WTA are likely due to the availability of prey species, such as capelin, herring, mackerel, and sand lance in this region (Kenney et al. 1985, Horwood 1989). Based on habitat information and predictive habitat models, Hamazaki (2002) determined that minke whales are likely to occur in nearshore waters off New Jersey.

Minke whales are most common off New Jersey in coastal waters in the spring and early summer as they move north to feeding ground in New England and fall as they migrate south (Geo-Marine 2010). Geo-Marine (2010) observed four minke whales near the WTA and surrounding waters during winter and spring. This species demonstrated a distinct seasonal habitat usage pattern that was consistent throughout the study. The two winter sightings were recorded in February, northeast of Barnegat Light whereas the two spring sightings were recorded in June, southeast of Sea Isle City. Minke whale sightings off the coast of New Jersey were within water depths of 36 to 79 ft (11 to 24 m) and temperatures ranging from 5.4 to 11.5 °C (47 °F) (Geo-Marine 2010).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammal. Common calls for minke whales found in the North Atlantic include repetitive, low-frequency (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short duration (50 to 70 milliseconds [ms]) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 ms) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a six to 14 minute pattern of 40 to 60 second pulse trains over several hours (Risch et al. 2013). Minke whales produce a unique sound called the “boing”, which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but unidentified for many years and had scientists widely speculating as to its source (Rankin and Barlow 2005).

4.1.3.2. Abundance

The best available abundance estimate for the Canadian East Coast minke whale stock is 21,968 individuals as of 2016 (Hayes et al. 2021). Current population trend and net productivity rates of minke whales in this region are unknown. The average annual human-caused mortality from 2014–2018 is approximately 10 whales per year, with nine deaths caused by entanglement in fishing gear and one death caused by vessel strikes (Hayes et al. 2021).

4.1.3.3. Status

Minke whales are not listed as Threatened or Endangered under the ESA or designated as a strategic stock under the MMPA.

4.1.4. North Atlantic Right Whale (*Eubalaena glacialis*)

NARW are among the most endangered of all marine mammal species in the Atlantic Ocean. The average adult NARW can grow to approximately 50 ft (15 m) in length, while calves are typically 14 ft (4 m) at birth (NOAA Fisheries 2018h). Members of this species 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. 2019). They are slow-moving grazers that feed on dense concentrations of prey at or below the water’s surface, as well as at depth (NOAA Fisheries 2018h). Female whales become sexually mature at about age ten and carry a single calf during a year-long gestation period every six to 10 years. The life span of NARW is estimated at 70 years, based on the estimated age of found deceased right whales and other closely related species (NOAA Fisheries 2021d).

NARWs are low-frequency cetaceans that vocalize using several distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al. 2014). One typical right whale vocalization is the “up call”: a short sweep that rises from roughly 50 to 440 Hz over a period of two seconds. These up calls are characteristic of the NARW and are used by research and monitoring programs to determine species presence. A characteristic “gunshot” call is believed to be produced by male NARWs. These pulses can have sound levels of 174 to 192 dB re 1 µPa with frequency range from 50 to 2,000 Hz (Parks et al. 2005, Parks and Tyack 2005). Other tonal calls range from 20 to 1,000 Hz and have sound levels between 137 and 162 dB re 1 µPa.

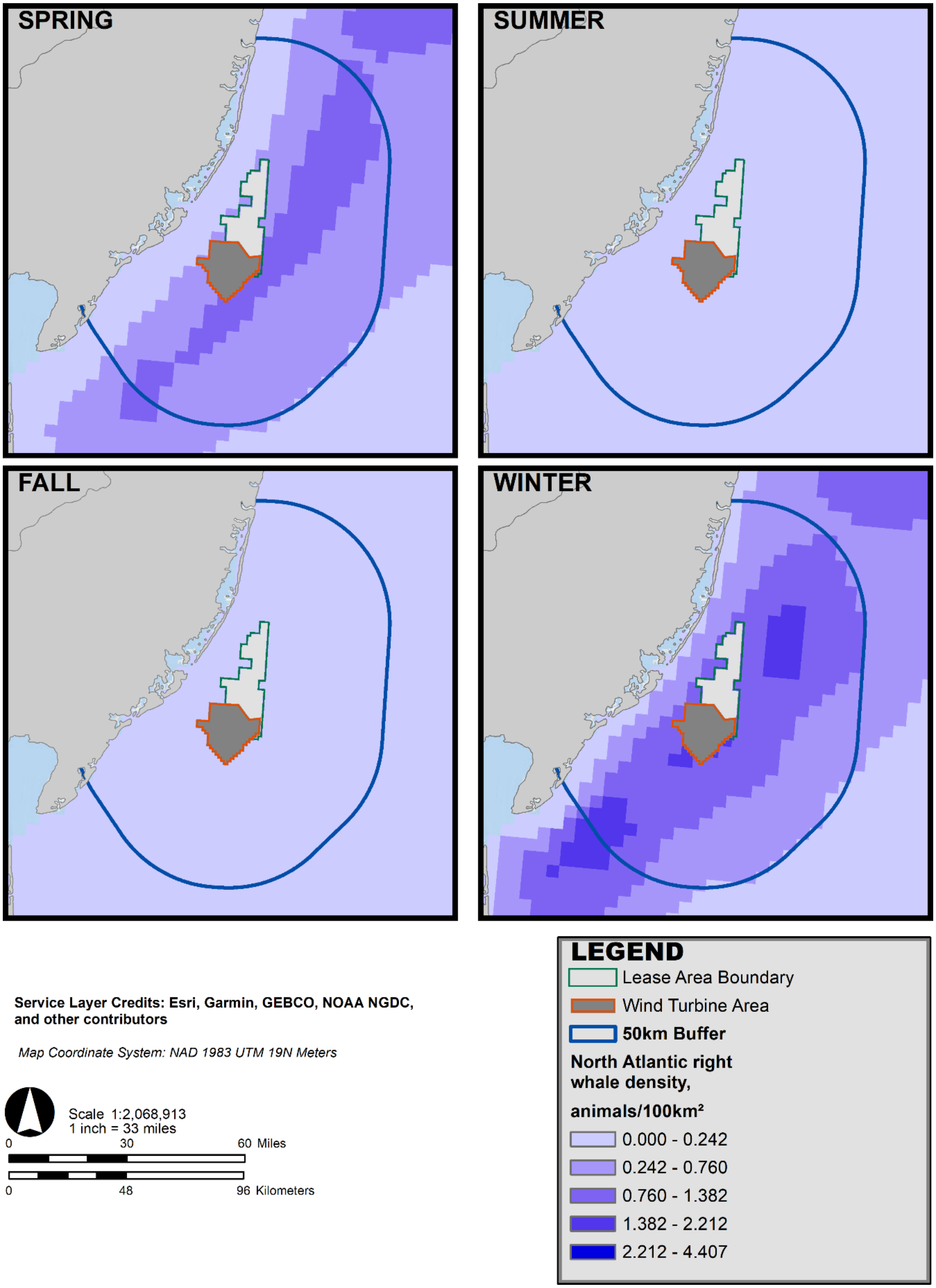
4.1.4.1. Distribution

NARWs in U.S. waters belong to the Western Stock. This stock 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. 2019). Surveys indicate that there are seven areas where NARWs congregate seasonally: the coastal waters of the southeastern U.S., 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). 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. 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). Davis et al. (2017) recently pooled together detections from a large number of passive acoustic devices and documented broad-scale use of much more of the Atlantic Seaboard than previously believed. Further, there has been an apparent shift in habitat use patterns (Davis et al. 2017), which includes an increased use of Cape Cod Bay (Mayo et al. 2018) and decreased use of the Great South Channel. Movements within and between habitats are extensive (Hayes et al. 2019), and there is a high interannual variability in NARW use of some habitats (Pendleton et al. 2009).

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the Mid-Atlantic region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). NARWs are mainly present in the WTA in winter, with another smaller peak in spring (Figure 9), ranging elsewhere for their main feeding and breeding/calving activities (Geo-Marine 2010). NARW typically occupy coastal and shelf waters within 56 mi (90 km) of the shoreline; however, they have been observed as far as 87 mi (140 km) offshore. These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the eastern U.S. coast to their calving grounds in the waters of the southeastern U.S. (Kenney and Vigness-Raposa 2010). The WTA is located within the NARW migration BIA. 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). Migrating NARWs have been detected acoustically north of the WTA in the New York Bight from February to May and then again in August through December (Biedron et al. 2009).

Historically, there have been several documented sightings of NARW off the coast of New Jersey and surrounding waters (CETAP 1982, Knowlton and Kraus 2001, Biedron et al. 2009). These waters are important migratory routes for NARW as this species travels to their feeding areas near the Gulf of Maine/Georges Bank regions and their breeding/calving grounds off the southeastern U.S. (DoC 2016b). Satellite-monitored radio tags on a NARW cow and calf documented the migratory route of this pair from the Bay of Fundy to New Jersey and back during a six-week period (Knowlton et al. 2002). A few NARW sightings were documented east of the south of the WTA near the Delaware Bay in October, December, May, and July (Knowlton et al. 2002). Other visual recordings of NARW were found in New Jersey waters during the spring and fall seasons (CETAP 1982). An entanglement mortality event of a NARW was recorded off the coast of New Jersey in October (Knowlton et al. 2002). It is has been noted, however, that NARW sightings in several traditional feeding habitats has been declining, causing speculation that a shift in NARW habitat usage may be occurring (Pettis et al. 2017).

Geo-Marine (2010) observed NARWs offshore of New Jersey during all seasons; except for summer. Three sightings of this species were documented in November, December, and January (Geo-Marine 2010). NARWs exhibit notable seasonal variability, with maximum occurrence in winter (December to February) and minimum occurrence in spring and summer. These sightings were likely to be migrant movements towards breeding and calving grounds located north and south of the Offshore Project Area (Winn et al. 1986, Cole et al. 2009). NARWs detected in the Geo-Marine (2010) study area off the coast of New Jersey were seen as single animals or pairs. These sightings occurred within water depths from 56 to 85 ft (17 to 26 m) with distances from shore ranging from 10.7 to 17.2 nm (19.9 to 31.9 km). A January 2009 sighting documented two adult males offshore of Barnegat Light in the northernmost portion of the Geo-Marine (2010) study area. In May 2008, a cow-calf pair were documented in waters (56 ft [17 m] isobath) southeast of Atlantic City (Geo-Marine 2010; M. Zani, New England Aquarium, pers. comm. 6 January 2020).



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Figure 9. North Atlantic right whale maximum seasonal density from Roberts et al. (2016a, 2021a, 2021b).

4.1.4.2. Abundance

The median estimate of abundance for the Western NARW stock is 412 (Hayes et al. 2021). This is based on a state-space model of the sighting histories of individual whales (Pace et al. 2017). This estimate does not consider that NARWs have been experiencing a UME since June 2017, with 30 documented deaths as of 2019 (NOAA Fisheries 2020b). The UME appears to be driven by entanglement in fishing gear and blunt force trauma associated with ship strikes mainly in the Gulf of St. Lawrence. From 2013 to 2017, there were 28 records of mortality or serious injury involving entanglement or fishery interactions. Cause of death findings for the UME are based on seven necropsies of dead NARWs found in Canada in the Gulf of St. Lawrence (Daoust et al. 2017, NOAA Fisheries 2021f) and along the Atlantic coast in U.S. water (NOAA Fisheries 2020b).

The Western NARW stock has been in decline since 2011 (Hayes et al. 2021). Population growth rates remain low (2.5%), as the average number of calves born per year in 1990–2017 was 16 and ranged from one to 39 per year. It appears as though that decline in NARW birth rates is continuing in more recent years, likely a result of lower female survival rate (Pace et al. 2017, Meyer-Gutbrod et al. 2020). The Apparent Productivity Index (API) (the number of calves detected/estimated abundance) for this stock has been highly variable over time (Hayes et al. 2019). The API for 2017 is not available because abundance has not been estimated for that year. However, with an assumed median estimate of abundance of 451 for NARWs (Pace et al. 2017), which also reported a 99.99% probability of NARW population decline from 2010 to 2015, the API would be well below replacement and would result in another decline in population size for 2017 (Hayes et al. 2019). In the four calving seasons since 2017, only five births have been observed in 2017, zero in 2018, seven in 2019, and ten in 2020 which is less than one-third the average annual birth rate for the NARW (NOAA Fisheries 2021d). Additionally, the NARW consortium has released the preliminary 2020 report card results predicting a NARW population of 356 (Pettis et al. 2021 in draft). However, the consortium adjusts their estimates (Pace et al. 2017) to subtract additional mortality. This method is used in order to estimate all mortality, not just the observed mortality, therefore the (Hayes et al. 2021) SAR is used in this LOA request to report an unaltered output of the Pace et al. (2017) model (DoC and NOAA 2005).

4.1.4.3. Status

The NARW was listed as a federally Endangered species in 1970 and remains critically Endangered throughout its range. In addition to its Endangered status, the high rate of annual human-related mortality classifies NARW as a strategic stock under the MMPA. The size of the Western Atlantic stock is considered extremely low relative to its Optimum Sustainable Population in the U.S. Atlantic EEZ (Hayes et al. 2021). The best available abundance size for the Western North Atlantic stock is 368 (NOAA Fisheries 2021b). The maximum productivity rate is 0.04, the default value for cetaceans, with a recovery factor of 0.1, because this species is listed as Endangered. Potential Biological Removal for the Western Atlantic stock of NARW is 0.7 (NOAA Fisheries 2021d). Historically, the population suffered severely from commercial overharvesting and has more recently been threatened by incidental fishery entanglement and vessel collisions (Knowlton and Kraus 2001, Kraus et al. 2005, Pace et al. 2017).

To protect this species from ship strikes, NOAA Fisheries designated Seasonal Management Areas in U.S. waters in 2008 (DoC 2008). All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10 knots (5.1 m/s) or less within these areas during specific time periods. NMFS may also establish Dynamic Management Areas when and where NARWs are sighted outside Seasonal Management Areas. Dynamic Management Areas are generally in effect for two weeks. During this time, vessels are encouraged to avoid these areas or reduce speeds to 10 knots (5.1 m/s) or less while transiting through these areas.

4.1.5. Sei Whale (*Balaenoptera borealis)*

Sei whales can reach lengths of about 39 to 59 ft (12 to 18 m) (NOAA Fisheries 2018k). This species has a long, sleek body that is dark bluish-gray to black in color and pale underneath (NOAA Fisheries 2018k). Their diet is comprised primarily of plankton including krill and copepods, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NOAA Fisheries 2018k).

Sei whales, like all baleen whales, are categorized as low-frequency cetaceans. There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly low-frequency (less than 1,000 Hz) vocalizations. Calls attributed to sei whales include pulse trains up to 3 kHz, broadband “growl” and “whoosh” sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (McDonald et al. 2005, Rankin and Barlow 2007, Baumgartner et al. 2008).

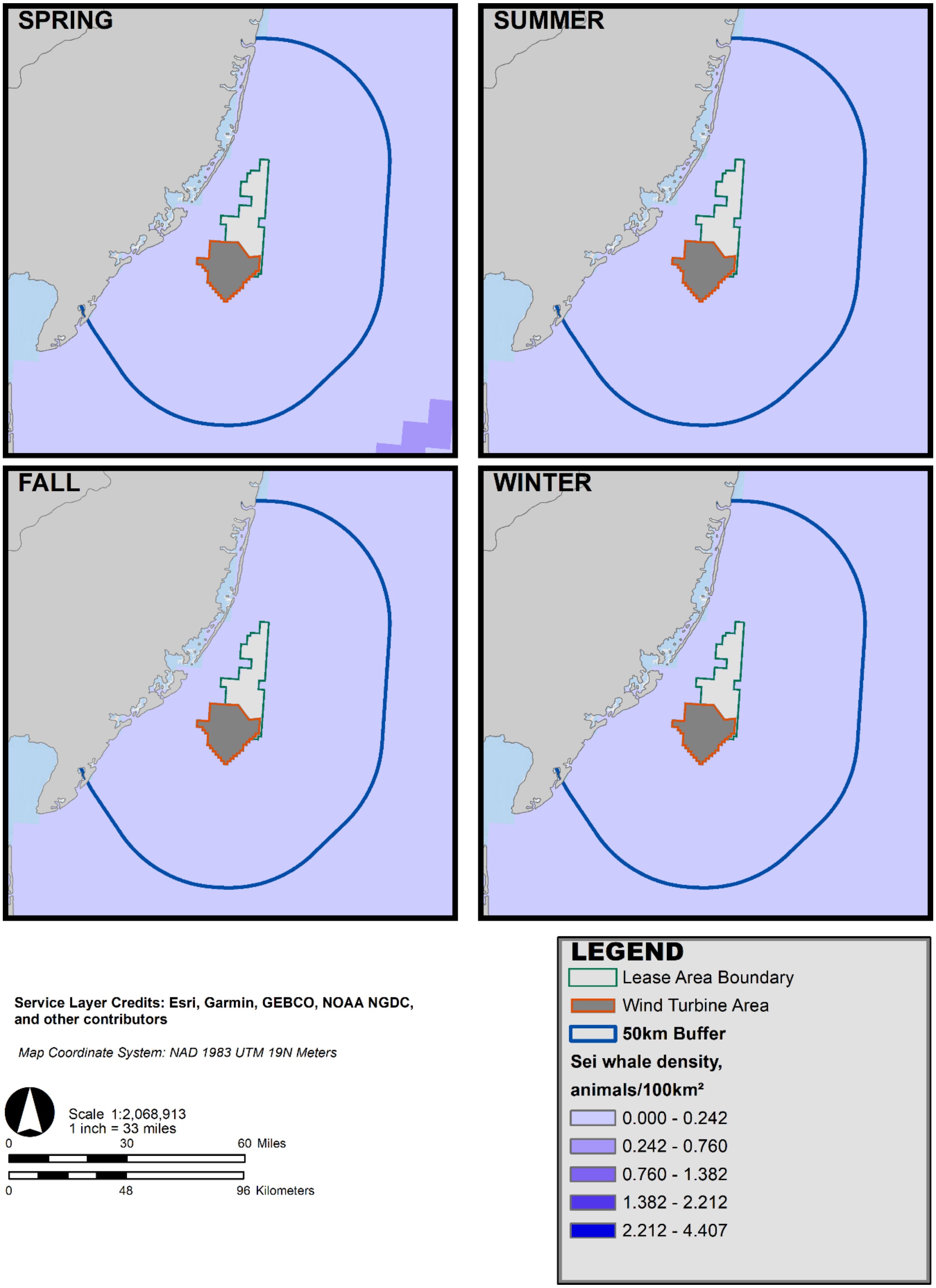
4.1.5.1. Distribution

The stock that occurs within the U.S. Atlantic EEZ is the Nova Scotia stock, which ranges along the continental shelf waters of the northeastern U.S. to Newfoundland (Hayes et al. 2017). Sei whales are relatively widespread. Sighting data suggest sei whale distribution is largely centered in the waters of New England and eastern Canada (Roberts et al. 2016a, Hayes et al. 2017). There appears to be a strong seasonal component to sei whale distribution, and they are most abundant in adjacent waters near the continental shelf from winter to spring (Roberts et al. 2016a) (Figure 10). This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters (Hayes et al. 2017). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (1987 and 1989) and Stellwagen Bank (1986) areas (Payne and Heinemann 1990, Waring et al. 2016). An influx of sei whales into the southern Gulf of Maine occurred in summer 1986 (Schilling et al. 1992). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

There has been little detection of sei whales within New Jersey and surrounding waters (Kenney et al. 1985, Geo-Marine 2010). According to the NJ ENSP, there have been no sightings of this species documented within State waters. On the shelf offshore of New Jersey, sei whales have been detected acoustically in early fall – approximately 200 sei whale vocalizations were detected in mid-September 2006 (Newhall et al. 2009, Newhall et al. 2012). However, it is unlikely that the sei whale will be present farther nearshore by the WTA.

4.1.5.2. Abundance

The best available abundance estimate for the Nova Scotia stock of sei whales from NMFS stock assessments is 6,292 individuals (Hayes et al. 2021). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and long survey intervals (Hayes et al. 2021).



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Figure 10. Sei whale maximum seasonal density from Roberts et al. (2016a, 2018).

4.1.5.3. Status

Sei whales are listed as Endangered under the ESA and NJ ENSP, and the Nova Scotia stock is considered strategic by NMFS. The minimum population size is estimated at 3,098. The maximum productivity rate is 0.04, the default value for cetaceans, with a recovery factor of 0.1, because this species is listed as Endangered. PBR for the Nova Scotia stock of sei whales is 6.2 (Hayes et al. 2021). For the period 2013 through 2017, the minimum annual rate of human-caused mortality and serious injury to sei whales was 1.0; however, due to haphazard detections this is a minimum estimate which is almost certainly biased low (Hayes et al. 2021). No critical habitat areas are designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs north of WTA in the Gulf of Maine from May through November (LaBrecque et al. 2015).

4.2. Odontocetes

4.2.1. Atlantic Spotted Dolphin (*Stenella frontalis)*

Atlantic spotted dolphins are found in warmer temperate and tropical waters of the Atlantic Ocean (NOAA Fisheries 2021c). They are a smaller moderately slender dolphin and attain a body length of 1.5 to 2.3 m (5 to 7.5 ft) (Perrin 2002). They have a tall, curved dorsal fin located midway down their back (NOAA Fisheries 2021c). The Atlantic spotted dolphins' color patterns vary with age and location, with most individuals seen north of Cape Hatteras exhibiting few small dark ventral spots (Perrin et al. 1987, Perrin 2002). They form groups of varying sizes, usually less than 50 individuals, but can be seen traveling in groups of more than 200. In shallower waters, group size is typically 5–15 individuals (NOAA Fisheries 2021c). These dolphins eat small fish, invertebrates, and cephalopods such as squid or octopi (Herzing 1997).

Atlantic spotted dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations, including signature whistles, range from 5 to 20 kHz (Perrin 2002). Calls produced by many delphinid species are highly variable and overlap in frequency characteristics, therefore, it is challenging to identify to individual species (Oswald et al. 2007) during acoustic studies.

4.2.1.1. Distribution

Atlantic spotted dolphins observed off the eastern US coast are part of the Western North Atlantic stock and range from southern New England south through the Gulf of Mexico and the Caribbean (Hayes et al. 2020). Atlantic spotted dolphins regularly occur along the continental shelf, in water depths typically between 33 and 650 ft (10 to 200 m) and deeper slope waters greater than 1,640 ft (500 m) deep. Two forms of the Atlantic spotted dolphin exist: one is large, heavily spotted, and usually inhabits the continental shelf, while the other is smaller in size, with fewer spots, and occurs farther offshore (Viricel and Rosel 2014). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin (*Stenella attenuata)* co-occur in some areas and can be difficult to differentiate (Hayes et al. 2020). Atlantic spotted dolphins may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966, Fritts et al. 1983). Atlantic spotted dolphins can be expected to occur in waters near the Offshore Project Area with the highest likelihoods in the fall, spring, and summer.

4.2.1.2. Abundance

The best available abundance estimate for the Western North Atlantic stock of Atlantic spotted dolphins is 39,921 individuals, estimated from data collected during summer surveys in 2016 covering waters from central Florida to the lower Bay of Fundy. Distinction between the two Atlantic spotted dolphin ecotypes has not regularly been made during surveys (Hayes et al. 2020).

4.2.1.3. Status

The total annual estimated human-caused mortality and serious injury to spotted dolphins between 2013 and 2017 was zero; there were no reported deaths from U.S. fisheries observer data (Hayes et al. 2020). The Atlantic spotted dolphin is not listed as Threatened or Endangered under the ESA, and the Western North Atlantic stock of Atlantic spotted dolphins is not classified as strategic.

4.2.2. Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

Atlantic white-sided dolphins are common in temperate waters of the western North Atlantic. They have a distinctive yellowish-tan patch near their fluke and white patches below the dorsal fin and ventral sides, on both sides of their long, slender bodies. These dolphins grow up to 9 ft (2.7 m) in length and weigh between 400 and 500 pounds as adults. Like other dolphins, Atlantic white-sided dolphins communicate vocally and non-vocally through signals. They produce burst-pulse sounds and echolocation clicks and whistles (Popper 1980).

4.2.2.1. Distribution

Atlantic white-sided dolphins observed off the U.S. Atlantic coast are part of the Western North Atlantic Stock (Hayes et al. 2019). This stock inhabits waters from central West Greenland to North Carolina (about 35° N), primarily in continental shelf waters to the 328 ft (100 m) depth contour (Doksæter et al. 2008). Sighting data indicate seasonal shifts in distribution (Northridge et al. 1997). From January to May, low numbers of Atlantic white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire). From June through September, large numbers of Atlantic white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, they occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). No critical habitat areas are designated for the Atlantic white-sided dolphin.

No Atlantic white-sided dolphins were observed in the Geo-Marine (2010) study. This suggests that Atlantic white-sided dolphins occur infrequently in the WTA and surrounding areas. The NJ ENSP noted that there is little information on the sightings of this species and that more information is needed to accurately assess the abundance of Atlantic white-sided dolphins within State waters (see CETAP 1982, Selzer and Payne 1988, Waring et al. 2007, Bowers-Altman and NJ Division of Fish and Wildlife 2009). A shallow water (~188 ft [36 m]) marine mammal survey off of New Jersey found no presence of Atlantic white-sided dolphin across each season (Kenney et al. 1985: p. 91), which further implies that it is unlikely for this species to be present within the WTA. Although regional surveys found very limited presence of this species near the WTA, data adapted from Roberts et al. (2016b, 2017, 2018) via the Marine-life Data and Analysis Team (Curtice et al. 2019) indicate abundance in this region increases in the spring.

4.2.2.2. Abundance

There are insufficient data to determine seasonal abundance estimates of Atlantic white-sided dolphins off the eastern U.S. coast or their status in the U.S. Atlantic EEZ. The best available abundance estimate for the Western North Atlantic stock of Atlantic white-sided dolphins is 93,233 individuals, estimated from data collected during the June to September 2016 surveys that covered nearly the entire western North Atlantic stock (Hayes et al. 2020).

4.2.2.3. Status

The Atlantic white-sided dolphin is not listed as Threatened or Endangered under the ESA or NJ ENSP, and the Western North Atlantic stock of Atlantic white-sided dolphins is not classified as strategic under the MMPA.

4.2.3. Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 7 to 13 ft (2 to 4 m) in length and are light gray to black in color (NOAA Fisheries 2018a). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NOAA Fisheries 2018a). They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, shrimp, and other crustaceans (Jefferson et al. 2008). Bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN 2008).

4.2.3.1. Distribution

There are multiple genetically distinct bottlenose dolphin stocks present in the Mid-Atlantic including the Western North Atlantic Offshore stock and Northern Migratory Coastal stock (Mead and Potter 1995). The Western North Atlantic Offshore stock inhabits the outer continental slope and shelf edge regions from Georges Bank to the Florida Keys (Hayes et al. 2017). Sightings of this stock of bottlenose dolphin occur from Cape Hatteras to the eastern end of Georges Bank (Kenney 1990). The Northern Migratory Coastal Stock migrates seasonally within coastal waters of the western North Atlantic. The coastal migratory stock typically inhabits nearshore waters with depths less than 80 ft (25 m) north of Cape Hatteras. During warmer months, this stock resides in waters to the 66 ft (~20-m) isobath within New York, Long Island, Virginia, and Assateague (Garrison et al. 2017b). During late summer, fall, and during cooler months (January to February), the Migratory Coastal stock occupies coastal waters from Cape Lookout, North Carolina to North Carolina/Virginia border (Garrison et al. 2017b).

Off the coast of New Jersey, bottlenose dolphins (likely from the Coastal Migratory stock, although there is thought to be some range overlap from the Offshore stock) can occur throughout the year and were the most frequently detected species in an ecological baseline survey conducted in coastal New Jersey waters (Geo-Marine 2010, BOEM 2012). Seasonal movements north along the coast occur during the warmer months, are likely directed by the presence of prey (Hayes et al. 2018). Targeted prey species vary by area, season, and stock; however, sciaenid fishes, such as Atlantic croaker, weakfish, and squid, are common (NOAA Fisheries 2021a). The Northeast Fisheries Science Center (NEFSC) observed bottlenose dolphins during the AMAPPS surveys (NEFSC and SEFSC 2011, 2012, 2014a, 2014b, 2015, 2016, 2018, 2019).

Bottlenose dolphins were the most frequently observed species during the Geo-Marine (2010) study period. A total of 319 bottlenose dolphins with group sizes averaging at 15.3 animals were detected offshore of New Jersey (Geo-Marine 2010). Several other monitoring efforts recorded sightings of this species during geophysical surveys in the potential windfarm sites (including the WTA) southeast of Atlantic City (Geo-Marine 2009a, 2009b). Bottlenose dolphins have been present annually near and offshore of New Jersey; with greater sightings during spring and summer months (Geo-Marine 2010).

4.2.3.2. Abundance

The best available population estimate for the northern migratory coastal stock is 6,639 bottlenose dolphins, while the offshore stock abundance is estimated at 62,851 individuals (Hayes et al. 2021). Current population estimates indicate there is no significant trend in abundance for either stock. Total annual human-caused mortality is unknown for both stocks. Total annual fisheries mortality and serious injury is estimated as 28 individuals for the offshore stock from 2013–2017 (Hayes et al. 2020).

4.2.3.3. Status

The offshore stock of bottlenose dolphin is not listed as Threatened or Endangered under the ESA or designated as a strategic stock under the MMPA. The northern migratory coastal stock of bottlenose dolphins is designated as a strategic stock under MMPA due to its depleted status and biased low fisheries mortality estimates (Hayes et al. 2021).

4.2.4. Pilot Whales (*Globicephala* spp.)

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale (*Globicephala melas*) and the short-finned pilot whale (*Globicephala macrorhynchus)*. These species are difficult to differentiate visually and acoustically due to similarity in appearance at the surface and vocalizations that overlap in frequency range. Consequently, the two species cannot be reliably distinguished (Rone and Pace 2012, Hayes et al. 2019); unless otherwise stated, the descriptions below refer to both species. Pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 24 ft (7.3 m) in length (NOAA Fisheries 2018f). These whales form large, relatively stable aggregations that appear to be maternally determined (American Cetacean Society 2018). Pilot whales feed primarily on squid but also eat small to medium-sized fish and octopus when available (NOAA Fisheries 2018f, 2018e). Occurrence of the long-finned pilot whale is considered rare in the WTA, while occurrence of the short-finned pilot whale is considered uncommon.

Pilot whales are acoustic mid-frequency specialists with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Pilot whales echolocate and produce tonal calls. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about one second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al. 2014).

4.2.4.1. Distribution

Within the U.S. Atlantic EEZ, both long- and short-finned pilot whales are categorized into Western North Atlantic stocks. In U.S. Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring (CETAP 1982, Payne and Heinemann 1993, Abend and Smith 1999, Hamazaki 2002). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982, Payne and Heinemann 1993). Short-finned pilot whales are present within warm temperate to tropical waters and long-finned pilot whales occur in temperate and subpolar waters. Long-finned and short-finned pilot whales overlap spatially along the Mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993, Hayes et al. 2019). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have stranded as far north as Massachusetts (Hayes et al. 2017). The latitudinal ranges of the two species therefore remain uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42° N, most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2019).

Long-finned and short-finned pilot whales have been known to occur offshore of New Jersey (Abend and Smith 1999, Tyler 2008, Hayes et al. 2017). It is likely that both species overlap along the shelf break between New Jersey and Georges Bank, however, there is limited information on the spatial and temporal distribution of both species near the WTA (Hayes et al. 2017). For instance, pilot whales were not detected during the Geo-Marine (2010) study. The limited information of pilot whale presence within the WTA is likely based on the habitat preference and overall distribution of pilot whales (Hayes et al. 2017). Further, the consensus from the NJ ENSP determined that pilot whales are primarily pelagic and have a rare presence in New Jersey waters (Bowers-Altman and NJ Division of Fish and Wildlife 2009).

4.2.4.2. Abundance

The best available abundance estimate for the Western North Atlantic stock of long-finned pilot whales is 39,215, and the best available abundance estimate for the Western North Atlantic stock of short-finned pilot whales is 28,924 (Lawson and Gosselin 2018, Hayes et al. 2020). Estimates of population trend or net productivity rates have not been calculated for long-finned pilot whales as abundance estimates remain highly uncertain due to long survey intervals. From 2013 to 2017, total annual observed fishery-related mortality or serious injury was 21 whales (Hayes et al. 2020). In addition to direct human-induced mortality, mass strandings of long-finned pilot whales have occurred throughout their range. Between 2013 and 2017,16 long-finned pilot whales were found stranded between Maine and Florida. There are three available coastwide abundance estimates from summer surveys in 2004, 2011 and 2016 for short-finned pilot whales. A logistical regression model was used and indicated no significant population trend. Currently net productivity rates are unknown for short-finned pilot whales (Hayes et al. 2020). The total annual human caused mortality between 2013–2017 is also unknown; however, the mean annual fishery-related mortality and serious injury during this time due to the pelagic long line fishery was 160 short-finned pilot whales (Hayes et al. 2020).

4.2.4.3. Status

Neither the long-finned or short-finned pilot whale species is listed as Threatened or Endangered under the ESA or the NJ ENSP, and the Western North Atlantic stock is not considered strategic under the MMPA.

4.2.5. Risso’s Dolphin (*Grampus griseus*)

Risso’s dolphins occur worldwide in both tropical and temperate waters (Jefferson et al. 2008, Jefferson et al. 2014). This species of dolphin attains a body length of approximately 9 to 13 ft (2.6 to 4 m) (NOAA Fisheries 2018m), a narrow tailstock, and a whitish or gray body. Risso’s dolphins form groups ranging from 10 to 30 individuals (NOAA Fisheries 2018m). They feed primarily on squid as well as fish, such as anchovies, krill, and other cephalopods (NOAA Fisheries 2018m). Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations range from 400 Hz to 65 kHz (DoN 2008).

4.2.5.1. Distribution

Risso's dolphins within the U.S. 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). 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). In winter, the distribution extends outward into oceanic waters (Payne et al. 1984) within the Mid-Atlantic Bight, however, very little is known about movement and migration patterns and they are infrequently observed in shelf waters. The stock may contain multiple demographically independent populations that should themselves be considered stocks because the current stock spans multiple eco-regions (Longhurst 1998, Spalding et al. 2007).

There is limited data regarding Risso's dolphins offshore of New Jersey. Increased strandings of this species were recorded from 2003 to 2004 on New York, New Jersey, and Delaware coasts (DiGiovanni et al. 2005). Other than strandings, this species has been primarily documented on the shelf break off of New Jersey (DiGiovanni et al. 2005). There were no Risso's dolphins documented during the Geo-Marine (2010) study. However, one Risso's dolphin observation was recorded during Atlantic Shores 2020 geophysical campaign in the Lease Area.

4.2.5.2. Abundance

The best abundance estimate for Risso's dolphins is 35,215 individuals, calculated from surveys conducted by NEFSC and Department of Fisheries and Oceans Canada (DFO) (NOAA Fisheries 2021b). Estimates of population trend or net productivity rates have not been calculated for Risso's dolphins. Annual average estimated human-caused mortality or serious injury from 2013 to 2017 was 54 dolphins, most of which was likely due to interactions with fisheries (Hayes et al. 2020).

4.2.5.3. Status

Risso's dolphins are not listed as Threatened or Endangered under the ESA and this stock is not considered strategic under the MMPA.

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

Short-beaked common dolphins (*Delphinus delphis*) are one of the most widely distributed cetaceans and occur in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked common dolphins can reach 9 ft (2.7 m) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NOAA Fisheries 2018i). This species feeds on schooling fish and squid found near the surface at night (NOAA Fisheries 2018i). Short-beaked common dolphins are in the mid-frequency functional hearing group. Their vocalizations range from 300 Hz to 44 kHz (Southall et al. 2007).

4.2.6.1. Distribution

Short-beaked common dolphins within the U.S. Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras to the Scotian Shelf (Hayes et al. 2018). Short-beaked common dolphins are a highly seasonal, migratory species. Within the U.S. Atlantic EEZ, this species is distributed along the continental shelf and is associated with Gulf Stream features (CeTAP 1982, Selzer and Payne 1988, Hamazaki 2002, Hayes et al. 2019). 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 (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 51.8 °F (11 °C) (Sergeant et al. 1970, Gowans and Whitehead 1995). Breeding usually takes place between June and September, with females estimated to have a calving interval of two to three years (Hayes et al. 2019).

There have been numerous sightings of short-beaked common dolphins throughout the New Jersey coastline (Ulmer 1981, Hamazaki 2002). Generally, this species has been documented 20 nm (>37 km) near the shelf break within the months of February, May, and July, however, they have been sighted throughout the year (Geo-Marine 2010). Short-beaked common dolphins are most common at the surface and are regularly observed in large groups consisting of hundreds of animals (NOAA Fisheries 2021e). Multiple strandings of the short-beaked common dolphins have occurred within the New Jersey coasts across multiple seasons (NOAA/NMFS 2004). Geo-Marine (2010) recorded a total of 32 short-short beaked common dolphin sightings off the coast of New Jersey. The observed species were documented in waters ranging from 33 to 102 ft (10 to 21 m) (Geo-Marine 2010). Approximately 26% of the shipboard sightings were calves during the Geo-Marine (2010) study.

4.2.6.2. Abundance

The best abundance estimate for the Western North Atlantic stock of short-beaked common dolphins is 172,974 individuals as of 2016 (Hayes et al. 2021). Annual total human-caused mortality and serious injury are unknown; however, annual fishery-related mortality between 2013 and 2017 was 419 animals (Hayes et al. 2021).

4.2.6.3. Status

The short-beaked common dolphin is not listed as Threatened or Endangered under the ESA and the Western North Atlantic stock of the short-beaked common dolphin is not designated as a strategic stock under the MMPA.

4.2.7. Sperm Whale (*Physeter macrocephalus*)

Sperm whales are the largest of the toothed whales and characterized by their large, bulbous heads. Adults can achieve 15 tons (females) to 45 tons (males). They mainly reside in deep-water habitats on the OCS, along the shelf edge, and in mid-ocean regions (NOAA Fisheries 2010). However, this species has also been observed in relatively high numbers in shallow continental shelf areas off the coast of southern New England (Scott and Sadove 1997). Sperm whale vocalizations include directional clicks, from less than 100 Hz to 30 kHz with most of the clicks is in the 5 to 25 kHz range. Sperm whales use echolocation and produce repeated patterns of clicks or codas, which are used to attract females, compete for mates, display aggression, and maintain group cohesion (Wahlberg 2002). Foraging sperm whales make regularly spaced clicks interrupted by “creaks” and very rapid clicking for locating and capturing prey (Wahlberg 2002; Richardson et al. 1995).

4.2.7.1. Distribution

Sperm whale migratory patterns are not well-defined, and no obvious migration patterns have been observed in certain tropical and temperate areas. However, general trends suggest that most populations move poleward during summer (Waring et al. 2015). Within U.S. Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982, Scott and Sadove 1997). During winter, sperm whales are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the Mid-Atlantic Bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the Mid-Atlantic region. In fall, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the Mid-Atlantic Bight.

There were no sperm whale sightings during the Geo-Marine (2010) study; however, approximately nine individuals were observed offshore of New Jersey near the OCS during shipboard surveys in summer 2011 (Palka 2012). There is substantial information on sperm whale occurrence offshore of New Jersey, but they are exclusively near the OCS (CETAP, 1982 Waring et al. 2007) and are unlikely to be present within the WTA. Figure 111 shows their seasonal densities near the Offshore Project Area.

4.2.7.2. Abundance

Though there is currently no reliable estimate of total sperm whale abundance in the entire western North Atlantic, the most recent and best available population estimate for the U.S. Atlantic EEZ is 4,349 (Hayes et al. 2020).

4.2.7.3. Status

Sperm whales are listed as Endangered under the ESA and NJ ENSP, and the North Atlantic stock is considered strategic by NMFS under the MMPA.

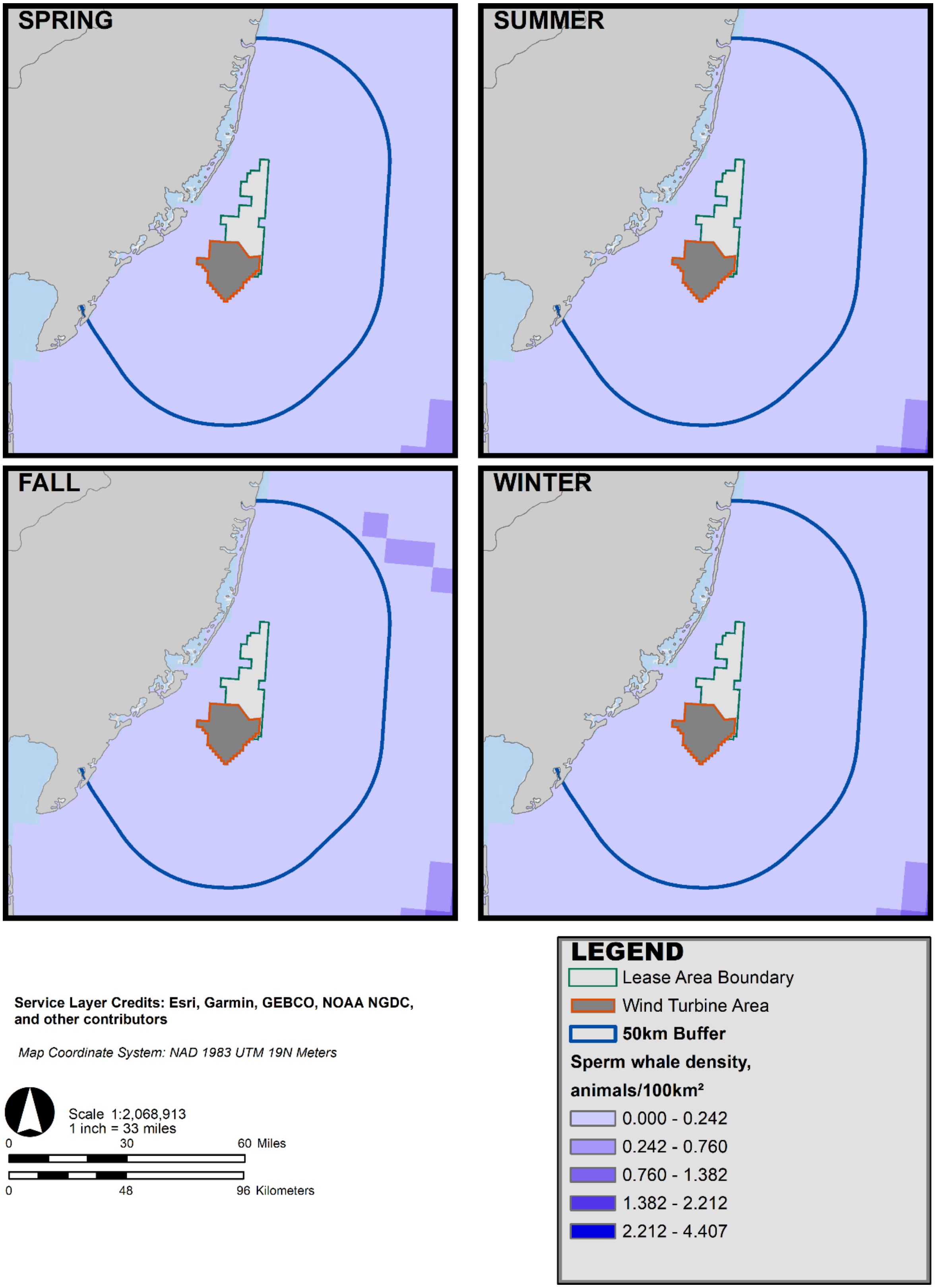


Figure 11. Sperm whale maximum seasonal density from Roberts et al. (2016a, 2016b, 2017).

4.2.8. Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is abundant throughout the coastal waters of the Northern hemisphere and the only porpoise species found in the Atlantic Ocean. This species is the smallest cetacean, with a blunt, short-beaked head, dark gray back, and white underside (NOAA Fisheries 2018g). Harbor porpoises reach a maximum length of 6 ft (1.8 m) and feed 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 are considered high-frequency cetaceans. The dominant component of harbor porpoise echolocation signals are narrowband, high-frequency clicks within 130 to 142 kHz (Villadsgaard et al. 2007).

4.2.8.1. Distribution

The harbor porpoise occupies both coastal and deep waters from off the coast of North Carolina to Greenland. They are commonly found in bays, estuaries, harbors, and fjords less than 656 ft (200 m) deep (NOAA Fisheries 2018g). Hayes et al. (2019) report that harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during summer (July to September). During fall (October to December) and spring (April to June), they are more widely dispersed from New Jersey to Maine. In winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina with lower densities found in waters off New York to New Brunswick, Canada (Hayes et al. 2019). There are four distinct populations of harbor porpoise in the western Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Hayes et al. 2019). Harbor porpoises observed within the U.S. Atlantic EEZ are considered part of the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises are a frequently sighted cetacean offshore of New Jersey (Geo-Marine 2010). During the Geo-Marine (2010) study, 51 harbor porpoises sightings were documented approximately 0.8 to 19.8 nm (1.5 to 36.6 km) from shore (mean = 10.5 nm/19.5 km). These sightings were primarily during winter months (February to March). It is therefore likely that this marine mammal will be present within the WTA.

4.2.8.2. Abundance

According to data collected in 2016 by NEFSC and DFO, the best abundance estimate for harbor porpoises is 95,543 individuals (Hayes et al. 2021). The total annual estimated human-caused mortality and serious injury is 217 harbor porpoises per year based on fisheries observer data (Hayes et al. 2021).

4.2.8.3. Status

Harbor porpoises are not listed as Threatened or Endangered under the ESA or the NJ ENSP or designated as a strategic stock under the MMPA.

4.3. Pinnipeds

Four species of pinnipeds are known to occur or could potentially occur in the Atlantic Ocean near the WTA: the harbor seal, gray seal, harp seal, and hooded seal. Like all pinnipeds, these animals have an amphibious lifestyle and are found nearshore (especially near their haul-out/ breeding sites) as well as in offshore waters. All four seal species are phocids, or true seals, having no external ears. The habitat range of hooded seals and harp seals is typically outside the Offshore Project Area, usually in deeper water, or they are so rarely sighted that their presence is unlikely and therefore they are not described further in this LOA request. The two remaining pinniped species are most likely to occur in the region during winter and early spring.

4.3.1. Gray Seal (*Halichoerus grypus)*

Gray seals are large, reaching 7 to 10 ft (2 to 3 m) in length, and have a silver-gray coat with scattered dark spots (NOAA Fisheries 2018j). 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 984 ft (300 m) and frequently forage on the OCS (Lesage and Hammill 2001, Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner 1971, Reeves 1992, Jefferson et al. 2008). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NOAA Fisheries 2018j). Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DoN 2008).

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4.3.1.1. Distribution

Gray seals are the second most common pinniped along the U.S. Atlantic coast (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 range from Canada to New Jersey; however, stranding records as far south as Cape Hatteras (Gilbert et al. 2005) have been recorded. 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, Lesage and Hammill 2001). There are three breeding concentrations in eastern Canada: Sable Island, Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In U.S. waters, gray seals primarily pup at four established colonies: Muskeget and Monomoy islands in Massachusetts, and Green and Seal Islands in Maine. Since 2010, pupping has also been observed at Noman’s Island in Massachusetts and Wooden Ball and Matinicus Rock in Maine (Hayes et al. 2019). Although white-coated pups have stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. Following the breeding season, gray seals may spend several weeks ashore in late spring and early summer while undergoing a yearly molt.

The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2003). For this reason, studies such as the Geo-Marine (2010) did not observe gray seals offshore of New Jersey. However, the Marine Mammal Stranding Center (2020) documented 25 gray seal strandings in 2019. Other reported sightings of gray seal in waters off of New Jersey were found as bycatch in gillnets

(Hatch and Orphanides 2017, Orphanides 2019). Gray seals are less likely than harbor seals to occur around the offshore ECC route or the WTA (Hayes et al. 2019).

4.3.1.2. Abundance

The gray seal is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and the Baltic Sea (Haug et al. 2013). The Western North Atlantic stock is equivalent to the Northwest Atlantic population, and ranges from New Jersey to Labrador (Mansfield 1966, Scott et al. 1990, Katona et al. 1993, Lesage and Hammill 2001). For U.S. waters alone gray seals have an estimated abundance of 27,300 (NOAA Fisheries 2021b).

4.3.1.3. Status

Gray seals are not listed as Threatened or Endangered under the ESA or the NJ ENSP, and they are not considered strategic under the MMPA.

4.3.2. Harbor Seal (*Phoca vitulina)*

Adult harbor seals are not sexually dimorphic and both males and females are light gray to dark brown in color and typically reach 4.9 ft (1.5 m) and 220 pounds in size with a 35-year lifespan (NOAA Fisheries Service 2017). Harbor seals forage in both shallow coastal waters and deeper offshore waters, diving to target prey within the water column or on the seafloor (Tollit et al. 1997). Primary food sources vary with seasonal abundances of fish and crustaceans in the north and Mid-Atlantic coastal region, with the most numerous prey species including sandlance, silver hake, Atlantic Herring, and redfish (NOAA Fisheries Service 2007).

Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories. These calls are comprised of “growls” or “roars” with peak energy at 200 Hz (Sabinsky et al. 2017). Captive studies have shown that harbor seals have good (greater than 50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al. 2009).

4.3.2.1. Distribution

Harbor seals are found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30° N and is the most abundant pinniped within the U.S. Atlantic EEZ (Hayes et al. 2019). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Richardson and Rough 1993) and occur seasonally from southern New England to New Jersey coasts between September and late May (Schneider and Payne 1983, Barlas 1999, Schroeder 2000). The western North Atlantic stock may occupy southern waters of the Mid-Atlantic Bight during seasonal migrations from the Bay of Fundy in the late autumn and winter (NMFS 2009; (Palka et al. 2017)). In addition to coastal waters, harbor seals utilize terrestrial habitat as haul-out sites throughout the year, but primarily during the pupping and molting periods, which occur from late spring to late summer in the northern portion of their range.

There are three major haul-out sites along the New Jersey coast, located in Great Bay, Sandy Hook, and Barnegay Inlet (CWFNJ 2015). In the western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally as far south as the Carolinas (Payne and Selzer 1989). A general southward movement from the Bay of Fundy to southern New England occurs in fall and early winter (Rosenfeld et al. 1988, Whitman and Payne 1990, Barlas 1999, Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada takes place prior to the pupping season, which occurs from mid-May through June along the Maine coast (Richardson 1976, Wilson 1978, Whitman and Payne 1990, Kenney 1994). Geo-Marine (2010) observed one harbor seal offshore of New Jersey during their survey effort.

4.3.2.2. Abundance

Although the stock structure of the Western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population that is termed the Western North Atlantic stock (Temte et al. 1991, Andersen and Olsen 2010). The best estimate of abundance for harbor seals in the Western North Atlantic stock is 61,336 (NOAA Fisheries 2021b). This estimate was derived from a coast-wide survey along the coast of Maine during May and June 2012.

4.3.2.3. Status

The Western North Atlantic stock of harbor seals are not listed as Threatened or Endangered under the ESA or the NJ ENSP, and they are not considered strategic under the MMPA.

5. Type of Incidental Taking Authorization Requested

5.1. Statement of Request

Atlantic Shores is requesting an LOA pursuant to section 101(a)(5)(A) of the MMPA for the incidental take by both Level A and Level B harassment of small numbers of marine mammals incidental to the impact pile driving of WTG and OSS foundations, HRG surveys, and vibratory installation of cofferdam sheet piles described in Section 1.4 for a period of up to five years beginning in 2025. The LOA is being requested specifically from January 1, 2025, through December 31, 2029. Exposure estimates predicted from modeling results indicate that Level A takes from impact pile driving are zero or negligible for most species and are greatly reduced when sound attenuation mitigation is employed. Level A exposures from HRG survey equipment are not expected given the short distances to Level A thresholds from this type of equipment and the mitigation measures to be implemented during the surveys (See Section 11), therefore, no Level A take is requested for these surveys. Level A exposures are also unlikely to occur from vibratory sheet pile installation and removal associated with the coffer dams, therefore, no Level A take is requested for this proposed activity. Atlantic Shores will attempt to avoid Level A takes during impact pile driving through mitigation; however, Level A takes are being requested as a precaution in the unlikely scenario that a marine mammal enters their respective Level A ensonified zone after pile driving has begun, and it is not feasible from an operational and/or safety perspective to cease the pile driving activity.

The mitigation measures described in Section 11 are designed to minimize the likelihood that Level A takes of any marine mammal species will occur. In particular, noise attenuation technology will be used to reduce impact pile driving sound levels by a target of at least 10 dB. Mitigation measures specifically focused on preventing Level A harassment of NARWs will also be implemented. Some of these measures will also be protective of other marine mammals and further support avoidance of unintentional and non-lethal take of these species by Level A or B harassment during construction of the Projects.

6. Take Estimates for Marine Mammals

Marine mammal take estimates were calculated for three sound-producing activities that could result in marine mammal Level A (impact pile driving only) and/or Level B (impact pile driving, HRG surveys, cofferdam installation/removal) harassment based on real-world densities of each species, estimates of ensonified areas, and the timing and intensity of the various construction activities. The marine mammal occurrence (densities and group sizes) used in take estimation for these three activities are provided in Section 6.1. The methods used to estimate marine mammal exposures are described in detail in the following subsections for impact pile driving (Section 6.2), vibratory pile driving for cofferdam installation/removal (Section 6.3), and HRG surveys (Section 6.4).

6.1. Marine Mammal Occurrence Used in Take Estimation

6.1.1. Marine Mammal Densities

This application, which was deemed adequate and complete by NMFS on August 25, 2022, used density estimates that were the best available at the time that it was submitted. More recent density estimates are now available from the 2022 Duke University Marine Geospatial Ecology Laboratory (MGEL) Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016, 2022). These models include updates for all species and higher resolution density information. Updates to the density, exposure, and take estimates using the 2022 MGEL models will be provided to NMFS in an external memo no later than September 28, 2022.

6.1.1.1. Densities Used for Impact Pile Driving Analysis

Mean monthly marine mammal density estimates (animals per 100 square kilometers [animals/100 km^2]) for all species are provided in Table 12. These were obtained using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016a, 2016b, 2017, 2018, 2021c, 2021b) and include recently updated model results for NARW (v11.1). The 2021 updated model includes new estimates for NARW abundance in Cape Cod Bay in December. Additionally, model predictions are summarized over three eras, 2003–2018, 2003–2009, and 2010–2018, to reflect the apparent shift in NARW distribution around 2010. The modeling conducted in support of this LOA application used the 2010–2018 density predictions.

Densities were calculated within a 3.9-km buffered polygon around the perimeter of lease area OCS-A 0499. The buffer size was selected as the largest 10 dB-attenuated exposure range over all species, scenarios, and threshold criteria with the exception of the Wood et al. (2012) thresholds. Wood et al. (2012) exposure ranges were not considered in this estimate since they include a small subset of very long ranges for migrating mysticetes and harbor porpoise. The mean density for each month was determined by calculating the unweighted mean of all 10 × 10 km (5 × 5 km for NARW) grid cells partially or fully within the analysis polygon (Figure 12). Densities were computed monthly, annually, and for the May through December period to coincide with proposed pile driving activities. For long- and short-finned pilot whales, monthly densities are unavailable from Roberts et al. (2016a, 2016b, 2017), so annual mean densities were used. Additionally, Roberts et al. (2016a, 2016b, 2017) provide density for pilot whales as a guild that includes both species. To obtain density estimates for long-finned and short-finned pilot whales, the guild density from Roberts et al. (2016a, 2016b, 2017) was scaled by the relative stock sizes based on the best available abundance estimate from NOAA Fisheries SARs (NOAA Fisheries 2021b). Equation 1 shows an example of how abundance scaling is applied to compute density for short-finned pilot whales:

$$d_{short-finned} = d_{both}\left(\frac{a_{short-finned}}{a_{short-finned} + a_{long-finned}}\right), \tag{1}$$

where a represents abundance and d represents density. Similarly, densities are provided for seals as a guild consisting primarily of harbor and gray seals (Roberts et al. 2016a, 2018). Gray and harbor seal densities were scaled by relative NOAA Fisheries SARs (NOAA Fisheries 2021b) abundance.

There are two stocks of bottlenose dolphins near the Project Area, coastal and offshore, but only one density model from Roberts et al. (2016a, 2018). Densities for the two stocks were calculated by splitting the buffer area at the 20-m isobath and estimating densities for the buffered area shallower than 20 m for the coastal stock and deeper than 20 m for the offshore stock.

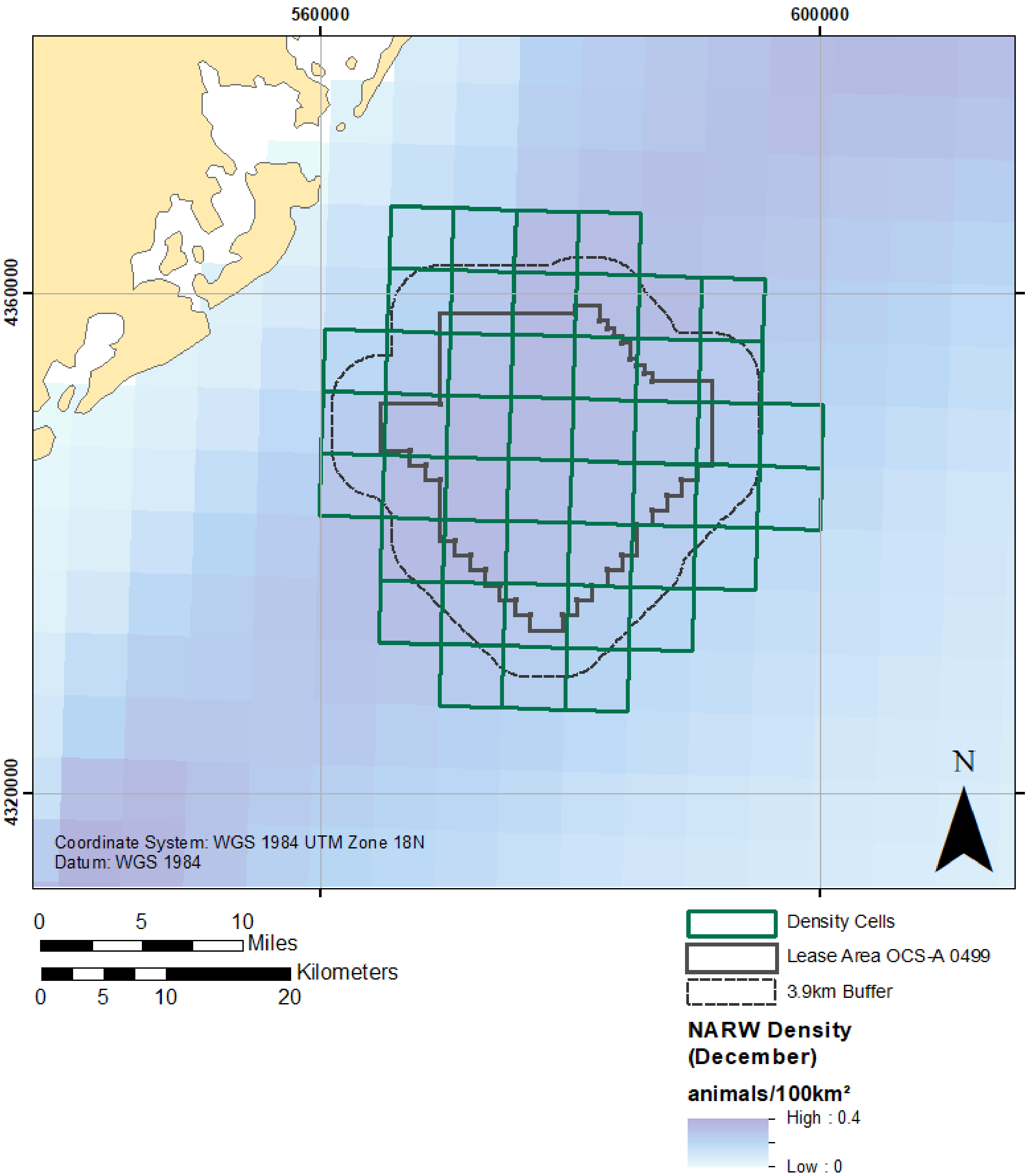

Figure 12. Marine mammal (e.g., NARW) density map showing highlighted grid cells used to calculate mean monthly species estimates within a 3.9 km buffer around the OCS-A 0499 lease area (Roberts et al. 2016a, 2016b, 2017, 2018, 2021c, 2021b).

Table 12. Mean monthly marine mammal density estimates for all modeled species within a 3.9 km buffer around the Atlantic Shores OCS-A 0499 Lease Area.

Species		Monthly density (animals/100 km^2)[a]												Annual mean	May to Dec mean
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
LF	Fin whale[b]	0.076	0.071	0.103	0.13	0.13	0.169	0.127	0.077	0.13	0.129	0.071	0.07	0.107	0.113
	Minke whale	0.025	0.03	0.028	0.09	0.105	0.055	0.008	0.004	0.009	0.029	0.012	0.018	0.035	0.03
	Humpback whale	0.072	0.048	0.042	0.025	0.031	0.025	0.008	0.006	0.018	0.04	0.025	0.083	0.035	0.03
	North Atlantic right whale[b]	0.562	0.628	0.685	0.607	0.059	0.004	0.002	0.001	0.002	0.003	0.026	0.275	0.238	0.047
	Sei whale[b]	0.001	0.001	0.000	0.008	0.006	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.001
MF	Atlantic spotted dolphin	0.004	0.002	0.006	0.02	0.028	0.075	0.109	0.2	0.198	0.064	0.051	0.013	0.064	0.092
	Atlantic white-sided dolphin	0.264	0.177	0.314	0.955	0.815	0.549	0.075	0.029	0.092	0.329	0.424	0.464	0.374	0.347
	Short-beaked common dolphin	4.975	1.513	1.118	1.985	2.197	2.133	2.31	2.424	1.924	4.07	4.702	8.674	3.169	3.554
	Bottlenose dolphin, coastal[c]	2.161	0.046	0.295	3.317	10.28	25.867	36.422	48.858	23.321	10.414	10.093	4.309	14.615	21.196
	Bottlenose dolphin, offshore[c]	1.597	0.149	0.271	1.224	2.976	8.075	10.01	13.946	9.101	4.332	3.289	2.007	4.748	6.717
	Risso’s dolphin	0.003	0.002	0.001	0.001	0.003	0.004	0.023	0.026	0.009	0.003	0.004	0.007	0.007	0.01
	Long-finned pilot whale[d]	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
	Short-finned pilot whale[d]	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
	Sperm whale[b]	0.000	0.000	0.000	0.001	0.004	0.016	0.02	0.017	0.017	0.008	0.004	0.001	0.007	0.011
HF	Harbor porpoise	2.34	4.438	5.626	2.345	0.501	0.01	0.02	0.026	0.008	0.112	1.539	2.358	1.61	0.572
PPW	Gray seal[e]	1.706	2.285	1.501	0.669	0.185	0.095	0.003	0.001	0.005	0.061	0.079	1.048	0.636	0.185
	Harbor seal[e]	3.833	5.133	3.373	1.504	0.415	0.213	0.008	0.003	0.011	0.136	0.178	2.354	1.43	0.415

[a] Density estimates are from habitat-based density modeling of the entire Atlantic Exclusive Economic Zone (EEZ) (Roberts et al. 2016a, 2016b, 2017, 2018, 2021b).

[b] Listed as Endangered under the ESA.

[c] For bottlenose dolphins, the 3.9 km buffer was split at the 20 m isobath: coastal, < 20 m; offshore >20 m.

[d] Long- and short-finned pilot whale densities are the annual pilot whale guild density scaled by their relative abundances.

[e] Gray and harbor seal densities are the seal guild density scaled by their relative abundances.

6.1.1.2. Densities Used for Vibratory Pile Driving for Cofferdam Installation and Removal

Densities used for calculating exposures resulting from vibratory pile driving were obtained from the Marine Geospatial Ecology Laboratory (MGEL)/Duke University Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b).

To calculate marine mammal densities for the potential vibratory pile driving impact area, JASCO assumed that the surveys would occur in two areas of interest: the Atlantic export cable landing site and the Monmouth export cable landing site. The density buffers were determined using the longest 95th percentile acoustic range to threshold ($R_{95\%}$) at each location. For the Atlantic site this was 7.546 km, and for the Monmouth site this was 11.268 km (see Table 4 of Appendix D). The buffers are shown as circles (using a dashed line) surrounding the two sites in Figure 13.

Monthly densities were extracted for each area of interest and for each species as the average of the densities from all MGEL/Duke model grid cells that overlap partially or completely with each area of interest. Cells entirely on land were not included, but cells that overlap only partially with land were included (Figure 13). The maximum annual density was calculated as the maximum of the monthly densities over the possible construction months: September to May, inclusive. The resulting densities are included in Table 13. Seals and pilot whales were scaled as described above in Section 6.1.1 (see Appendix D for additional details).

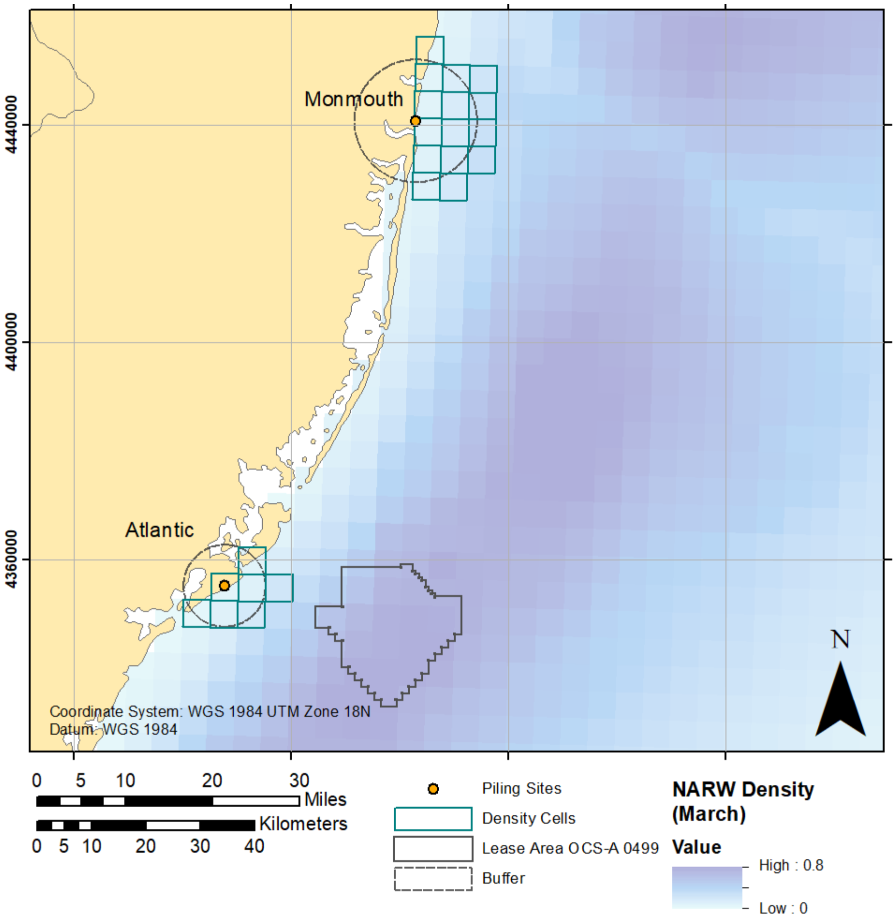

Figure 13. Marine mammal (e.g., NARW) density map showing highlighted grid cells used to calculate maximum seasonal species densities at each vibratory piling location (Roberts et al. 2016a, 2016b, 2017, 2018, 2021c, 2021b).

Table 13. Maximum annual density (animals per 100 km^2), estimated from September to May, at each of the two vibratory piling sites.

Species	Monmouth	Atlantic
Fin whale	0.073	0.046
Minke whale	0.014	0.009
Humpback whale	0.122	0.169
North Atlantic right whale	0.142	0.134
Sei whale	0.004	0.001
Atlantic spotted dolphin	0.016	0.004
Atlantic white-sided dolphin	0.133	0.065
Short-beaked common dolphin	1.797	0.657
Bottlenose dolphin, coastal	13.296	58.741
Bottlenose dolphin, offshore	0.000	0.000
Risso’s dolphin	0.001	0.000
Long-finned pilot whale	0.003	0.001
Short-finned pilot whale	0.002	0.001
Sperm whale	0.004	0.001
Harbor porpoise	7.796	2.810
Gray seal	5.272	4.234
Harbor seal	11.845	9.513

6.1.1.3. Densities Used for HRG Survey Analysis

Densities used in estimating marine mammal exposures from HRG surveys were taken from Roberts et al. habitat-based density models. Average seasonal modeled densities were calculated for each species for the survey area as described in Section 6.2 and shown in Figure 14. For the survey area, the densities as reported by Roberts et al. were averaged by season (spring [March-May], summer [June – August], fall [September – November], and winter [December – February]). To support the most conservative estimates of take over a 12-month period, Atlantic Shores applied the maximum average seasonal density values for each marine mammal to the calculation (see Appendix C for additional detail).

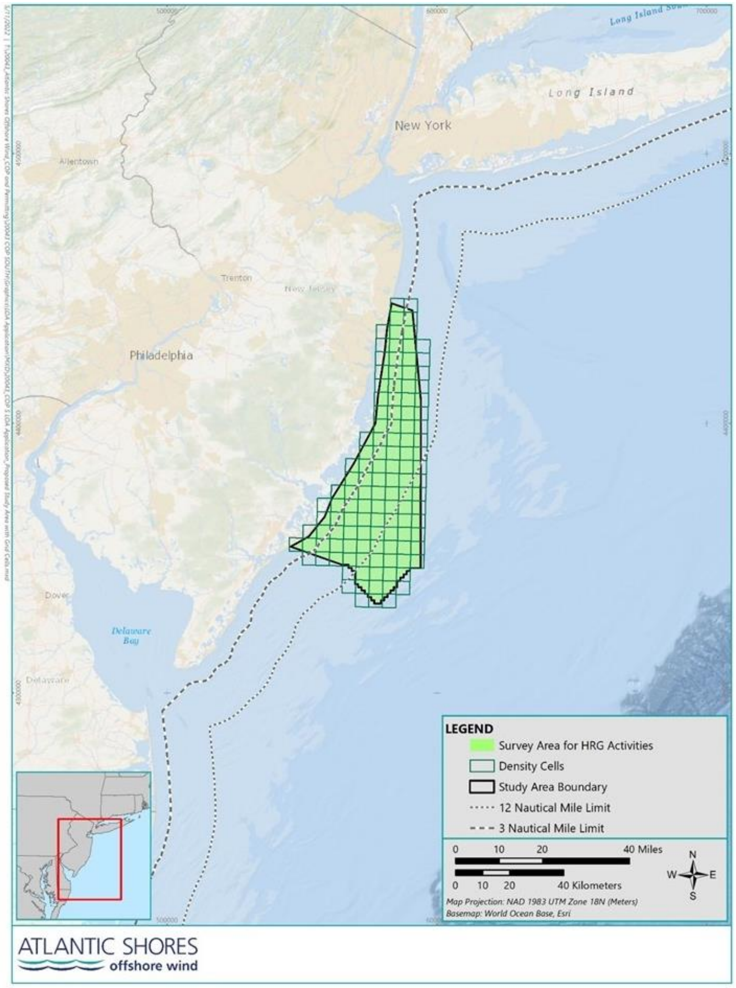

Figure 14. HRG survey area used to calculate densities.

Table 14. Maximum monthly densities used to estimate Level B exposures from HRG surveys.

Species		Maximum seasonal density (animals/100 km2)
LF	Fin whale[a]	0.079
	Minke whale	0.037
	Humpback whale	0.082
	North Atlantic right whale[a]	0.321
	Sei whale[a]	0.003
MF	Atlantic spotted dolphin	0.062
	Atlantic white-sided dolphin	0.332
	Short-beaked common dolphin	2.247
	Bottlenose dolphin, coastal	29.295
	Bottlenose dolphin, offshore	29.295
	Risso's dolphin	0.006
	Pilot whale, long-finned	0.025
	Pilot whale, short-finned[b]	NA
	Sperm whale[a]	0.009
HF	Harbor porpoise	3.035
PPW	Gray seal	4.409
	Harbor seal	4.409

[a] Listed as Endangered under the ESA.

[b] No short-finned pilot whale exposures are anticipated, so no density was calculated.

6.1.2. Marine Mammal Mean Group Size

The mean group sizes used in the take estimation (Table 15) were derived from NMFS' data uploaded to the Ocean Biodiversity Information System (OBIS) data repository (OBIS 2022). These include data from AMAPPS 2010–2019 aerial and shipboard surveys, NARW aerial surveys, and others. All data for each species were downloaded from OBIS. The data were then filtered to include only observations from the Northwest Atlantic (approximately the Gulf of Maine to Cape Hatteras and out to the shelf edge) and limited to data with owner institution code = "NMFS". Average group size was calculated as the mean value of "individualCount" for all sighting records. Additionally, marine mammal group size was informed by previous site characterization surveys in the area performed by Atlantic Shores and as used in the currently active IHA for site characterization surveys (NOAA Fisheries 2022). These group sizes – 20 for long-finned pilot whales, 100 for Atlantic spotted dolphins, and 30 for Risso's dolphins – were used instead of the OBIS data for these three species.

In calculating Level B takes from the acoustic exposure results for impact pile driving, if the predicted mean annual Level B exposure exceeded the mean group size for a given species, the take was not corrected for group size – the requested takes for those species are equal to the predicted Level B exposures rounded up to the nearest integer. However, if the predicted mean annual Level B exposure was less than the mean group size for a given species, it was assumed that if one group member was exposed, then all animals in the same group would receive a similar level of sound exposure. The requested annual take for that species was set equal to one mean group size rounded up to the nearest integer. This generally only occurs for species with low densities and is used as a conservative measure to ensure all animals in a group are accounted for in the take request in the event that these uncommon species occur in the area during pile driving.

Initial observations of the model-predicted exposure estimates for common dolphins for impact pile driving appear to be low given what is known about this species range in the shallow waters of the Project Area. The model is being updated for this species. In the interim, take estimates in this LOA request are based on the average number of animals observed daily during site characterization surveys conducted by Atlantic Shores and as used in their currently active IHA for site characterization surveys (NOAA Fisheries 2022), which was informed by previous site characterization surveys in the area. This value of 1.55 common dolphins seen daily was multiplied by the number of pile driving days, following the same approach used in the HRG take estimates for this species (see Appendix C).

Table 15. Mean group size of modeled marine mammal species that could be present in the Offshore Project Area that were used in calculating take estimates for impact pile driving and HRG surveys.

Species	Mean group size[a]
Fin whale[b]	1.3
Minke whale	1.1
Humpback whale	1.8
North Atlantic right whale[b]	3.8
Sei whale[b]	2.1
Atlantic spotted dolphin	100
Atlantic white-sided dolphin	21.4
Short-beaked common dolphin	1.55
Bottlenose dolphin	13.1
Risso’s dolphin	30
Long-finned pilot whale	20
Short-finned pilot whale	6.0
Sperm whale[b]	1.8
Harbor porpoise	1.8
Gray seal	1.3
Harbor seal	1.2

[a] Mean group sizes for Atlantic spotted dolphin, Risso's dolphin, and long-finned pilot whale are from Atlantic Shores currently active IHA for site characterization surveys ((NOAA Fisheries 2022)) and are informed by previous site characterization surveys in the area; common dolphin mean group size is based on the daily sighting rate of that species from those surveys; all other group sizes are from OBIS data (OBIS 2022).

[b] Listed as Endangered under the ESA.

6.2. Exposure Estimation – Impact Pile Driving

To estimate potential effects on marine mammals (i.e., Level A and Level B harassment) from sound generated during the Projects' impact pile driving activities JASCO performed underwater acoustic modeling of these activities on behalf of Atlantic Shores. The basic modeling approach is to characterize the sounds produced by the source, determine how the sounds propagate within the surrounding environment, then estimate species-specific exposure probabilities by combining the computed sound fields with animal movement in simulated representative scenarios. The resulting species-specific exposure probabilities are then converted into predicted numbers of individuals of each species that could be exposed to sounds above the Level A and Level B acoustic thresholds to generate take estimates based on the number of piles installed monthly for the 2 years of the proposed construction schedule for both Projects. The modeling methodology is described in the following sections and provided in greater detail in the JASCO acoustic impact assessment report (Appendix B).

Calculations of take from impact pile driving are provided in detail in the following subsections and in Section 6.5. Briefly, the methods and assumptions used in the modeling to estimate marine mammal exposures above acoustic thresholds and to use those to calculate takes resulting from impact pile driving are as follows:

- Predicted sound fields from the acoustic modeling were combined with animal movement modeling to provide probabilistic exposure estimates (mean number of simulated animals [i.e., animats] likely to exceed a given acoustic threshold over a 24-hour period given a pre-determined animat density, Section 6.2.1).
- 24-hour animat exposures resulting from the modeling were scaled, for each species or species' guild, by the ratio of their monthly density (Roberts et al. 2016a, 2016b, 2017, 2018, 2021b) to the modeled animat density for each month (Section 6.1.1.1).
- The number of piling days per month was used in conjunction with the monthly 24-hour animat exposures to estimate project-level exposures by year.
- Level A exposure estimates are provided for both the cumulative sound exposure level (SELcum) and peak pressure level (PK) thresholds (Section 6.2.5) – the greater of the SELcum and PK exposure estimates for each species was selected to compute Level A takes.
- Level B exposure estimates are provided as sound pressure level (SPL) for both the NOAA (2005) 160 dB re 1 µPa SPL and Wood et al. (2012) weighted behavioral response criteria (Section 6.2.5) – the 160 dB re 1 µPa SPL criterion was selected to compute Level B takes.
- Exposure estimates are provided for various levels of sound attenuation (0, 6, 10, and 15 dB) for the Full Buildout (Tables 24–26) and for Project 1 (Table 27) and Project 2 (Tables 28–30); take calculations assumed 10 dB sound attenuation is achievable based on current studies (Bellmann et al. 2020).
- All exposure estimates and average group sizes were rounded up to a whole number, before any addition, to compute takes. Average group sizes were obtained from sightings data uploaded to the Ocean Biodiversity Information System (OBIS) data repository (OBIS 2022) (Section 6.1.1.2).
- When the predicted yearly Level B take based on exposure modeling was less than one average group size for a given species, the requested take is one average group size for the species rounded up to a whole number (Section 6.1.1.2).
- Level B take estimates for common dolphins are based on the daily sighting rate (1.55 animals per day) of this species during site characterization surveys.

- As a conservative measure, takes are based on Construction Schedule 2 (Table 8), which assumes all piled foundations are jacket foundations installed at a rate of four 5 m pin piles per day.
- The total take request for the Projects is based on the modeled exposure results for each species for the two construction years combined (Section 6.5).

6.2.1. Modeling Methods Overview

6.2.1.1. Source Modeling

JASCO's 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 2010b) to predict source levels associated with impact pile driving activities. The sound radiating from the pile itself was simulated as a vertical array of discrete point sources. Acoustic fields produced by impact pile driving for jacket and monopile foundations (WTG and OSS) were modeled at two sites representing the range of water depths within the Offshore Project Area. This modeling approach takes into account parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. The JASCO acoustic impact assessment report (Appendix A) provides a more detailed description of the source modeling.

Forcing functions were computed for 5 m diameter jacket foundation piles and 15 m monopile foundations using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010a). 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 models used to estimate equivalent acoustic source characteristics. Decidecade spectral source levels for each pile type, hammer energy, and modeled location, using an average summer sound speed profile, are provided in the JASCO acoustic impact assessment report (Appendix A). The 15 m monopile is the maximum diameter considered under the PDE, therefore this diameter was used for the modeling[7].

6.2.1.2. Sound Propagation Modeling

Acoustic propagation modeling used JASCO's Marine Operations Noise Model (MONM) and Full Wave Range Dependent Acoustic Model (FWRAM) that combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate sound fields. The lower frequency bands were modeled using MONM-RAM, which is based on the parabolic equation method of acoustic propagation modeling. For higher frequencies, additional losses resulting from absorption were added to the propagation loss model. See Appendix A for a more detailed description.

Jacket foundation piles were assumed to be pre- and post-piled. Pre-piling means that the jacket structure will be set on pre-installed piles. Post-piling means that the jacket structure is placed on the seafloor and piles are subsequently driven through guides at the base of each leg. These jacket foundations will also radiate sound as the piles are driven. To account for the larger radiating area including the jacket structure, the broadband sound level estimated for the jacket piles was increased by 2 dB for post-piling scenarios.

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[7] A 12 m monopile was also modeled but was not carried through to exposure estimates. Modeling results for the 12 m are available in Appendix A for comparison.

6.2.1.3. Animal Exposure Modeling

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) is an animal movement model that integrates estimated sound fields with species-typical behavior (e.g., dive patterns) in simulated animals (animats). Estimated received sound levels relative to regulatory thresholds for species' hearing groups were calculated for each animat that may occur in the Offshore Project Area. By simulating animal movement, the sound fields are sampled in a realistic manner for each species of concern near the sound source, providing species-specific estimates of potential acoustic exposure.

6.2.1.4. Sound Attenuation

Several hypothetical broadband sound attenuation levels (0, 6, 10, and 15 dB) were included in the JASCO modeling study for comparison purposes. In estimating takes for this LOA request, impacts to marine mammals were conservatively assessed based on 10 dB of noise attenuation. See additional information on noise attenuation systems in Section 11. The full modeling results, showing all levels of attenuation, can be found in the acoustic impact assessment report (Appendix A).

6.2.1.5. Acoustic and Exposure Modeling: Scope and Assumptions

Under the maximum design scenario described in Section 1.2, Atlantic Shores is proposing to install up to 200 WTGs, one met tower, and four large OSS foundations. Two types of foundations were considered in the acoustic modeling study – monopile foundations and jacket pile foundations – to assess potential effects of impact pile driving to marine mammals.

Three potential construction schedules (shown in Section 2.2) were evaluated to estimate potential exposures of marine mammals to sounds above the Level A and Level B acoustic threshold criteria from impact pile driving during the anticipated 1- or 2-year construction period (May 2026 through December 2027). As noted in Section 2.2, as a conservative approach, Schedule 2 (Table 8) was carried forward to the take calculations. Exposure results for Schedule 2 are presented in Section 6.2.5, and results for Schedules 1 and 3 are provided in Appendix A. As noted above, Construction Schedule 2 assumed all WTGs and OSSs as well as the met tower would be installed on jacketed foundations at a rate of four 5-m pin piles per day. Table 8 shows the number of days, as well as the number of piles per month and per year that pile driving is anticipated to occur under proposed Construction Schedule 2. Table 8 also provides the total piling days, total number of piles, and total number of foundations modeled for each of the two construction years as well as for the total buildout of the Projects.

6.2.2. Acoustic Criteria – Level A and Level B Harassment

To assess the potential impacts of sound sources associated with the Projects, it is necessary to first establish the acoustic exposure criteria used by U.S. regulators to estimate marine mammal takes. In 2016, NOAA Fisheries issued a Technical Guidance document that provides acoustic thresholds for onset of permanent threshold shift (PTS) in marine mammal hearing for most sound sources, which was updated in 2018 (NMFS 2016, 2018). The Technical Guidance document also recognizes two main types of sound sources: impulsive and non-impulsive. Non-impulsive sources are further broken down into continuous and intermittent categories.

The Guidance recommends the use of dual criteria for assessing Level A exposures, including a peak (unweighted/flat) sound level metric (PK) and a cumulative SEL metric with frequency weighting. Both the acoustic criteria and weighting function application are divided into functional hearing groups (e.g., low-, mid-, and high-frequency for cetaceans) that species are assigned to, based on their respective hearing ranges. The acoustic analysis used for this LOA request applies the most recent sound exposure criteria used by NMFS to estimate Level A acoustic harassment (NMFS 2018).

Sound levels thought to elicit disruptive behavioral response are described using the SPL metric (NOAA 2005). NMFS currently uses behavioral response thresholds of 160 dB re 1 µPa for impulsive sounds and 120 dB re 1 µPa for continuous sounds for all marine mammal species (NMFS 2018), based on observations of mysticetes (Malme et al. 1983, 1984, Richardson et al. 1986, 1990). Alternative thresholds used in acoustic assessments include a graded probability of response approach that takes into account the frequency-dependence of animal hearing sensitivity (Wood et al. 2012). Exposure predictions from the modeling study used both the NMFS' 160 dB re 1 µPa threshold for impulsive sounds (NOAA 2005) and the Wood et al. (2012) criteria for comparison. For the Wood et al. (2012) criteria, harbor porpoise were presumed to be a sensitive species and 75% of NARW were presumed to be migrating while the other 25% were assumed to be foraging (i.e., not included in the more sensitive migrating mysticete category). See Table 19 for the percent probabilities of response under the Wood et al. (2012) criteria and Appendix A for additional details. The exposure results using the Wood et al. (2012) criteria are presented in this LOA request for comparison purposes only. The NOAA (2005) criteria were used in the Level B take request.

The publication of ISO 18405 *Underwater Acoustics – Terminology* (ISO 2017) provided a dictionary of underwater bioacoustics (the previous standard was ANSI and ASA S1.1-2013). The JASCO modeling follows the definitions and conventions of ISO (2017) except where stated otherwise (Table 16).

Table 16. Summary of relevant acoustic terminology used by U.S. regulators and in the JASCO modeling report.

Acoustic metric	NMFS (2018)	ISO (2017)	
		Main text	Tables
Sound pressure level	n/a	SPL	L_p
Level of peak sound pressure	PK	PK	L_{pk}
Cumulative sound exposure level	SEL_{cum}*	SEL	L_E

* The SEL_{cum} metric used by the NMFS describes the sound energy received by a receptor over a period of 24 h. Accordingly, following the ISO standard, this will be denoted as SEL in this LOA request, except for in tables where L_E is used.

6.2.2.1. Marine Mammal Hearing Groups

Data and predictions show that marine mammal species differ in their hearing capabilities, in absolute hearing sensitivity as well as frequency band of hearing (Richardson et al. 1995, Wartzok and Ketten 1999, Southall et al. 2007, Au and Hastings 2008). While hearing measurements are available for a small number of species based on captive animal studies, there are no direct measurements of many odontocetes or any mysticetes. As a result, hearing ranges for many odontocetes are grouped with similar species, and predictions for mysticetes are based on other methods including: anatomical studies and modeling (Houser et al. 2001, Parks et al. 2007, Tubelli et al. 2012, Cranford and Krysl 2015); vocalizations (see reviews in Richardson et al. 1995, Wartzok and Ketten 1999, Au and Hastings 2008); taxonomy; and behavioral responses to sound (Dahlheim and Ljungblad 1990, see review in Reichmuth et al. 2007). In 2007, Southall et al. proposed that marine mammals be divided into hearing groups. This division was updated in 2016 and 2018 by NOAA Fisheries using more recent best available science (Table 17).

Southall et al. (2019) published an updated set of Level A sound exposure criteria (i.e., for onset of TTS and PTS in marine mammals). While the authors propose a new nomenclature and classification for the marine mammal functional hearing groups, the proposed thresholds and weighting functions do not differ in effect from those proposed by NMFS (2018). The new hearing groups proposed by Southall et al. (2019) have not yet been adopted by NOAA Fisheries. The NMFS (2018) hearing groups presented in Table 17 are used in this analysis.

Table 17. Marine mammal hearing groups (Sills et al. 2014, NMFS 2018).

Hearing group	Representative species or species' groups	Generalized hearing range[a]
Low-frequency (LF) cetaceans	Mysticete whales	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans	Most odontocetes, e.g., delphinids, sperm whales, beaked whales	150 Hz to 160 kHz
High-frequency (HF) cetaceans	Other odontocetes, e.g., porpoises, Kogia spp.	275 Hz to 160 kHz
Phocid pinnipeds in water (PW)	Harbor and grey seals	50 Hz to 86 kHz
Phocid pinnipeds in air (PPA)b		50 Hz to 36 kHz

[a] The generalized hearing range is for all species within a group. Individual hearing will vary.

[b] Sound from piling will not reach NMFS thresholds for behavioral disturbance of seals in air (90 dB [rms] re 20 µPa for harbor seals and 100 dB [rms] re 20 µPa for all other seal species) at the closest land-based sites where seals may spend time out of the water. Thus in-air hearing is not considered further.

6.2.2.2. Marine Mammal Auditory Weighting Functions

The potential for anthropogenic sound to impact marine mammals is largely dependent on whether the sound occurs at frequencies that an animal can hear well unless the sound pressure level is so high that it can cause physical tissue damage regardless of frequency. Auditory (frequency) weighting functions reflect an animal's ability to hear a sound (Nedwell and Turnpenny 1998, Nedwell et al. 2007). Auditory weighting functions have been proposed for marine mammals, specifically associated with PTS thresholds (Southall et al. 2007, Erbe et al. 2016a, Finneran 2016). Marine mammal auditory weighting functions for all hearing groups (Table 17) published by Finneran (2016) are included in the NMFS (2018) Technical Guidance for use in conjunction with corresponding PTS (Level A) onset acoustic criteria (Table 18). Wood et al. (2012) behavioral response criteria use the M-weighting functions proposed by Southall et al. (2007).

The application of marine mammal auditory weighting functions emphasizes the importance of taking measurements and characterizing sound sources in terms of their overlap with biologically important frequencies (e.g., frequencies used for environmental awareness, communication, and the detection of predators or prey), and not only the frequencies that are relevant to achieving the objectives of the sound producing activity (i.e., context of sound source; NMFS 2018).

6.2.2.3. Level A Harassment Exposure Criteria

Injury to the hearing apparatus of a marine mammal may result from a fatiguing stimulus measured in terms of SEL, which considers the sound level and duration of the exposure signal. Intense sounds may also damage hearing independent of duration, so an additional metric of peak pressure (PK) is also used to assess acoustic exposure injury risk. A PTS in hearing may be considered injurious, but there are no published data on the sound levels that cause PTS in marine mammals. There are data that indicate the received sound levels at which temporary threshold shift (TTS) occurs, therefore PTS onset may be extrapolated from TTS onset level using an assumed growth function (Southall et al. 2007). The NOAA Fisheries (2018) criteria incorporate the best available science to estimate PTS onset in marine mammals from sound energy accumulated over 24 hours (SEL), or very loud, instantaneous peak sound pressure levels. These dual threshold criteria of SEL and PK are used to calculate potential marine mammal Level A exposures resulting from pile driving (Table 18).

Table 18. Summary of relevant PTS onset acoustic thresholds for marine mammal hearing groups (NMFS 2018).

Faunal group	Impulsive signals[a]	
	Unweighted L_{pk} (dB re 1 µPa)	Frequency weighted $L_{E,\mathrm{24h}}$ (dB re 1 µPa^{2}s)
Low-frequency (LF) cetaceans	219	183
Mid-frequency (MF) cetaceans	230	185
High-frequency (HF) cetaceans	202	155
Phocid seals in water (PW)	218	185

[a] Dual-metric acoustic thresholds for impulsive sounds: The largest isopleth result of the two criteria is used for calculating PTS onset.

6.2.2.4. Level B Harassment Exposure Criteria

Numerous studies on marine mammal behavioral responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioral reactions. It is recognized that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison et al. 2012). Due to the complexity and variability of marine mammal behavioral responses to acoustic exposure, NOAA Fisheries has not yet released technical guidance on behavioral thresholds for calculating animal exposures (NMFS 2018). NOAA Fisheries currently uses an SPL of 160 dB re 1 µPa to assess behavioral impact (NOAA 2005), which assumes that all animals exposed to sound at or above 160 dB re 1 µPa are taken by Level B harassment. This metric was derived from the HESS (1999) report that showed a 50% probability of inducing behavioral responses at this SPL, which was based on the responses of migrating mysticete whales to air gun sounds (Malme et al. 1983, 1984). The HESS team recognized that behavioral responses to sound may occur at lower levels, but substantial responses were only likely to occur above an SPL of 140 dB re 1 µPa.

An extensive review of behavioral responses to sound was undertaken by Southall et al. (2007, their Appendix B). Southall et al. (2007)They found varying responses for most marine mammals between SPLs of 140 and 180 dB re 1 µPa, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit step functions. These criteria were reviewed again recently by an extended version of this panel of experts, who suggested incorporating new methodological developments into data collection for behavioral response assessment (Southall et al. 2021). The panel did not recommend new behavioral exposure criteria, but they do advocate for analysis and reporting of a broader range of noise exposure conditions, rather than a single received level metric, and for the use of noise exposure metrics that are context and subject specific. Tyack and Thomas (2019) explored using a dose-response function to evaluate behavioral responses, whereby the probability of an animal responding is a function of the received sound level at a given distance from the source. They provide a simple example showing how using a single sound metric grossly underestimates the number of animals affected in comparison with the dose-response function. In 2012, Wood et al. (2012) proposed a graded probability of response for impulsive sounds using a frequency-weighted SPL metric. They also designated behavioral response categories for sensitive species (including harbor porpoises and beaked whales) and for migrating mysticetes. The JASCO modeling included both the NOAA (2005) criterion and the Wood et al. (2012) step-function. A comparison of the exposure estimates derived from these two behavioral acoustic criteria (see Table 19) are shown in Tables 20–26. For the purpose of this comparison, harbor porpoise were considered to be sensitive and 75% of NARW were considered to be migrating, with the remainder included in the "All other species" group shown in Table 19. Detailed results of this modeling can be found in the JASCO acoustic impact assessment report (Appendix A). For the purpose of the LOA request, the NOAA (2005) criterion is used to calculate Level B takes.

Table 19. Acoustic thresholds used in the acoustic modeling to evaluate potential behavioral impacts to marine mammals. Units are sound pressure level. Probabilities are not additive.

Marine mammal group	Species	Frequency weighted probabilistic response[a] (L_p, dB re 1 µPa)				Unweighted threshold[b] (L_p, dB re 1 µPa)
		120	140	160	180	160
Sensitive odontocetes	Harbor porpoise (*Phocoena phocoena*)	50%	90%	–	–	100%
Migrating mysticete whales	North Atlantic right whale (*Eubalaena glacialis*)	10%	50%	90%	–	100%
All other species		–	10%	50%	90%	100%

[a] Wood et al. (2012).

[b] NMFS recommended threshold (NOAA 2005).

6.2.3. Animal Movement Modeling and Exposure Estimation

JASMINE was used to estimate the probability of exposure of animals to threshold levels of sound arising from pile driving operations during construction of the Projects. Sound exposure models such as JASMINE use animats to sample the predicted 3-D sound fields with movement rules derived from animal observations (Appendix A). The parameters used for forecasting realistic behaviors (e.g., diving, foraging, aversion, and surface times) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. The predicted sound fields are sampled by the model receivers in a way that real animals are expected to by programming animats to behave like marine species that may be present in the Offshore Project Area. The output of the simulation is the exposure history for each animat within the simulation. An individual animat's sound exposure level is evaluated over a specified duration (i.e., 24 h) to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria described in Section 6.2.2 within each analysis period. The number of animats predicted to receive sound levels exceeding the thresholds indicates the probability of such exposures, which is then scaled by the real-world density estimates for each species to obtain the mean number of real-world animals estimated to potentially receive above-threshold sound levels (Figure 15).

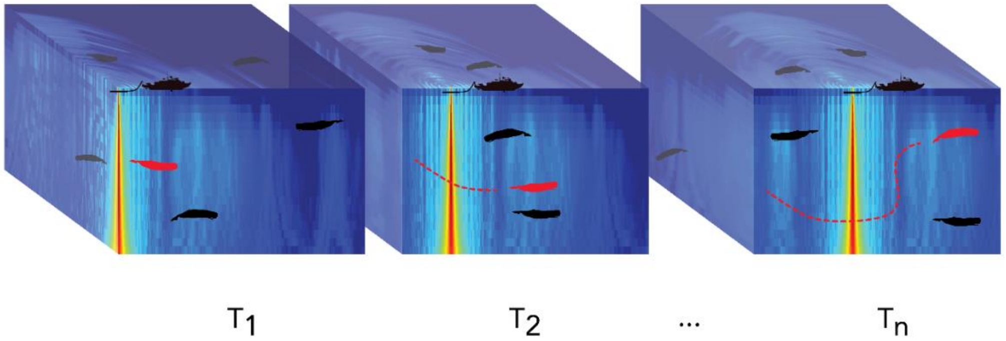

Figure 15. Depiction of animats in an environment with a moving sound field. Example animat (red) shown moving with each time step. The acoustic exposure of each animat is determined by where it is in the sound field, and its exposure history is accumulated as the simulation steps through time.

Due to shifts in animal density and seasonal sound propagation effects, the number of animals predicted to be impacted by the pile driving operations is sensitive to the number of foundations installed during each month. Additional details can be found in Appendix A.

6.2.4. Exposure-based Ranges to Thresholds – Impact Pile Driving

Animal movement and exposure modeling can be used to account for the movement of receivers when estimating distances for monitoring zones. The closest point of approach (CPA) for each of the species-specific animats during a simulation is recorded and then the CPA range that accounts for 95% of the animats that exceed an acoustic impact threshold is determined (Figure 16). The $ER_{95\%}$ (95% Exposure Range) is the horizontal distance that includes 95% of the CPAs of animats exceeding a given impact threshold. $ER_{95\%}$ is reported for each metric (PK, SEL, and SPL). If used as an exclusion zone, keeping animals farther away from the source than the $ER_{95\%}$ will reduce exposure estimates by 95%.

Tables 20–23 summarize the exposure range results for each of the foundation types and installation schedules.

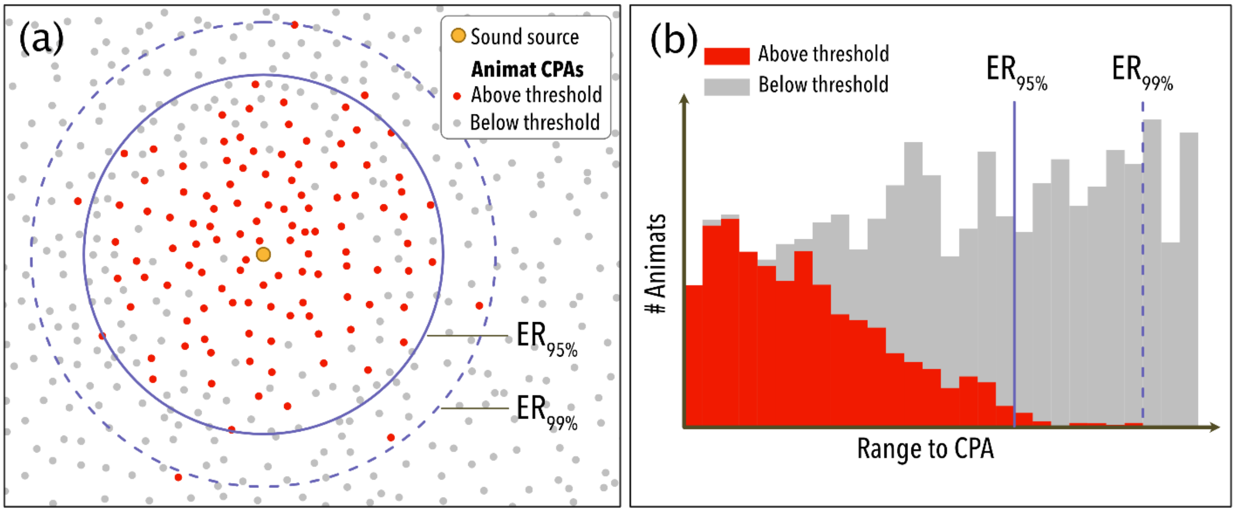

Figure 16. Example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animats near a sound source. Panel (b) shows the distribution of ranges to animat CPAs. The 95% and 99% Exposure Ranges ($ER_{95\%}$ and $ER_{95\%}$) are indicated in both panels.

Within the tables in this section, exposure range estimates of exactly "0" indicate that there were no modeled exposures above threshold and therefore the range to threshold is 0 km. If the range is "<0.01", there were exposures above threshold but the computed range was less than 0.01 km.

Exposure ranges for two monopiles per day versus one monopiles per day are not greatly different from each other (or consistently larger or smaller) because the driving of each pile are effectively independent events. What differences can be seen are largely due to different instances of JASMINE being run since it is a Monte Carlo simulation. An animat might accumulate more energy over two piles per day in a 24-hour period, but that accumulation of energy is not directly correlated to their exposure range. As described above, the exposure range is the range at which 95% of the animats within that range were exposed, and this may not change greatly between a one per day scenario and two per day scenario as the two piles are essentially treated as separate events. See Appendix B for more details of the modeling process.

Table 20. Monopile foundation (15 m diameter, one pile per day) exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation[e].

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c] (sei whale[c,d])	3.33	2.13	1.81	0.53	0.03	0	0	0	6.41	4.69	3.73	2.88	6.66	4.83	3.77	2.93
	Minke whale	2.11	0.95	0.35	0.06	0.01	0	0	0	5.92	4.46	3.48	2.78	6.13	4.58	3.51	2.79
	Humpback whale	3.59	2.19	1.25	0.47	0.03	<0.01	0	0	6.35	4.64	3.77	2.89	6.50	4.72	3.82	2.89
	North Atlantic right whale[c] (migrating)	2.64	1.30	0.72	0.37	0.03	<0.01	<0.01	<0.01	6.33	4.64	3.65	2.85	15.05	12.10	10.42	8.16
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.25	4.56	3.56	2.79	3.41	2.37	1.74	1.00
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	5.54	4.28	3.87	0	3.69	0	0	0
	Bottlenose dolphin, offshore	0	0	0	0	<0.01	0	0	0	5.89	4.50	3.50	2.73	3.31	2.31	1.54	0.82
	Risso's dolphin	0	0	0	0	0	0	0	0	6.29	4.74	3.71	2.92	3.52	2.46	1.85	0.93
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	1.42	0.50	0.26	0.02	0.60	0.28	0.20	0.05	6.36	4.66	3.74	2.86	20.21	16.53	14.39	11.69
PPW	Gray seal	0.56	0.17	0.02	0.02	0.05	0	0	0	6.57	4.74	3.77	2.96	5.29	3.57	2.93	2.05
	Harbor seal	0.84	0.14	<0.01	0	0.05	<0.01	0	0	6.65	4.72	3.79	2.95	5.37	3.56	2.93	2.04

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Fin whale used as a surrogate for sei whale behavioral definition.

[e] Different levels of attenuation are provided for comparison; however, 10 dB was carried forward to the take request as the level of attenuation that Atlantic Shores is committed.

Table 21. Monopile foundation (15 m diameter, two piles per day) exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation[e].

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[a] (sei whale[a,b])	3.45	2.15	1.83	0.45	0.05	0.02	0	0	6.33	4.67	3.74	2.85	6.56	4.78	3.79	2.91
	Minke whale	2.15	0.95	0.41	0.07	0.05	<0.01	0	0	5.86	4.38	3.45	2.78	6.16	4.50	3.51	2.79
	Humpback whale	3.53	2.08	1.29	0.42	0.04	0.02	<0.01	<0.01	6.32	4.66	3.68	2.87	6.52	4.76	3.72	2.88
	North Atlantic right whale[a] (migrating)	2.68	1.37	0.72	0.39	0.04	0	0	0	6.24	4.58	3.61	2.84	14.89	11.94	10.20	8.07
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.06	4.61	3.58	2.86	3.39	2.46	1.80	0.98
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	5.58	4.39	3.90	0	3.77	0	0	0
	Bottlenose dolphin, offshore	0	0	0	0	<0.01	<0.01	<0.01	0	5.98	4.40	3.42	2.66	3.25	2.29	1.60	0.89
	Risso's dolphin	0.02	0	0	0	0	0	0	0	6.15	4.56	3.68	2.83	3.49	2.50	1.75	0.97
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[a]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	1.41	0.72	0.28	0.03	0.63	0.28	0.17	0.07	6.23	4.61	3.61	2.87	19.94	16.57	13.96	11.60
PPW	Gray seal	0.67	0.26	0	0	0.04	0.02	0	0	6.46	4.77	3.71	2.96	5.29	3.61	2.94	2.10
	Harbor seal	0.61	0.11	<0.01	<0.01	0.05	<0.01	0	0	6.35	4.89	3.76	2.94	5.35	3.63	2.84	2.09

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Fin whale used as a surrogate for sei whale behavioral definition.

[e] Different levels of attenuation are provided for comparison; however, 10 dB was carried forward to the take request as the level of attenuation that Atlantic Shores is committed.

Table 22. Pre-piled jacket foundation (5 m diameter pin piles, four piles per day) exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation[e].

	Species	Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[a] (sei whale[a,b])	3.71	2.17	1.80	0.50	<0.01	<0.01	0	0	5.36	3.55	2.87	2.04	5.45	3.59	2.88	2.04
	Minke whale	2.41	1.03	0.40	0.06	0.02	0	0	0	5.01	3.45	2.77	1.88	5.14	3.48	2.78	1.88
	Humpback whale	3.71	2.12	1.07	0.42	0.01	0	0	0	5.31	3.66	2.91	1.96	5.43	3.66	2.93	1.97
	North Atlantic right whale[a] (migrating)	3.13	1.49	0.73	0.19	0.01	0	0	0	5.25	3.49	2.87	1.91	15.27	11.79	9.69	7.20
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.01	0.01	0	0	0	0	0	0	5.27	3.46	2.85	1.88	3.77	2.62	1.74	0.92
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	4.84	3.78	0	0	3.87	0	0	0
	Bottlenose dolphin, offshore	0.13	0	0	0	0	0	0	0	4.98	3.28	2.74	1.72	3.59	2.46	1.56	0.81
	Risso's dolphin	0.02	<0.01	<0.01	0	<0.01	0	0	0	5.24	3.51	2.89	1.93	3.83	2.64	1.77	0.93
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[a]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	3.23	1.87	1.11	0.42	0.34	0.17	0.09	0.04	5.24	3.56	2.90	1.95	24.88	20.45	17.92	14.68
PPW	Gray seal	1.49	0.59	0.15	0	0.04	0	0	0	5.53	3.62	2.94	2.03	4.76	3.11	2.51	1.49
	Harbor seal	1.52	0.79	0.16	0.02	0.02	0	0	0	5.41	3.69	3.02	1.97	4.74	3.21	2.55	1.43

[a] NOAA (2005).
[b] Wood et al. (2012).
[c] Listed as Endangered under the ESA.
[d] Fin whale used as a surrogate for sei whale behavioral definition.
[e] Different levels of attenuation are provided for comparison; however, 10 dB was carried forward to the take request as the level of attenuation that Atlantic Shores is committed.

Table 23. Post-piled jacket foundation[a] (5 m diameter pin piles, four piles per day) exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation[e].

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d] (sei whale[d,e])	4.17	2.56	1.90	0.71	0.04	<0.01	0	0	6.20	4.20	3.16	2.42	6.33	4.30	3.19	2.43
	Minke whale	3.02	1.42	0.69	0.15	0.06	0.01	0	0	5.62	3.90	3.05	2.31	5.79	3.95	3.07	2.31
	Humpback whale	4.34	2.58	1.56	0.69	0.05	0.01	0	0	6.09	4.13	3.18	2.39	6.21	4.14	3.19	2.39
	North Atlantic right whale[d] (migrating)	3.53	1.94	1.06	0.47	0.06	0	0	0	5.97	4.11	3.16	2.37	16.56	12.80	10.74	8.05
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.01	0.01	0.01	0	0	0	0	0	5.83	4.02	3.11	2.31	4.35	2.95	2.15	1.23
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	5.31	4.02	0	0	4.17	0	0	0
	Bottlenose dolphin, offshore	0.21	0	0	0	0	0	0	0	5.65	3.80	3.01	2.14	4.24	2.84	2.05	1.11
	Risso's dolphin	0.02	0.02	<0.01	0	<0.01	0	0	0	5.90	4.12	3.14	2.31	4.41	2.97	2.14	1.23
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	3.86	2.29	1.48	0.62	0.43	0.23	0.13	0.04	5.92	4.14	3.13	2.40	26.65	21.84	19.13	16.01
PPW	Gray seal	1.90	0.86	0.24	0.04	0.04	0	0	0	6.06	4.27	3.19	2.44	5.62	3.58	2.88	1.88
	Harbor seal	2.09	0.88	0.32	0.10	0.02	<0.01	0	0	6.05	4.29	3.23	2.49	5.51	3.58	2.87	1.84

[a] Post-piled jacket foundations include a 2 dB shift for post piling.

[b] NOAA (2005).

[c] Wood et al. (2012).

[d] Listed as Endangered under the ESA.

[e] Fin whale used as a surrogate for sei whale behavioral definition.

[e] Different levels of attenuation are provided for comparison; however, 10 dB was carried forward to the take request as the level of attenuation that Atlantic Shores is committed.

6.2.5. Exposure Estimates – Impact Pile Driving

The subsections below show the mean number of marine mammals predicted to experience sound levels from impact pile driving exceeding the Level A and Level B harassment thresholds for the full buildout of Atlantic Shores (Section 6.2.5.1) as well as for the Project 1 (Section 6.2.5.2) and Project 2 (Section 6.2.5.3) breakdown. These exposure estimates are calculated using Construction Schedule 2, as described in Section 2.2, which was carried forward to the take calculations. Exposure estimates as predicted by Schedules 1 and 3 are provided in Appendix A for comparison. Exposure estimates used species densities derived from habitat-based models (provided in Section 6.1.1). These numbers may not be reflective of the current state of certain species' populations, e.g., NARW, but are the best available data for this application.

6.2.5.1. Full Buildout

The model-predicted exposure estimates by species for the full buildout are provided in Tables 24–26, assuming 0, 6, 10, and 15 dB broadband attenuation for year 1 and year 2 of Construction Schedule 2 as well as for both years combined. Year 1 and year 2 impact pile driving activities are expected to occur in 2026 and 2027 (see Table 7 for more detail). These exposure estimates are calculated using Construction Schedule 2 for the full buildout (Table 8) as described in Section 2.2, which was carried forward to the take calculations.

Table 24. Construction Schedule 2, year 1 – Full Buildout: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		**Injury**								**Behavior**							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								**Attenuation (dB) [c]**							
		0	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**
LF	Fin whale[d]	34.11	19.33	11.45	4.98	0.06	0.03	0	0	51.26	36.77	30.72	21.29	45.23	29.95	22.93	15.76
	Minke whale	31.93	12.93	4.79	0.87	0.03	<0.01	0	0	71.91	51.67	42.05	28.17	51.51	36.10	29.23	20.75
	Humpback whale	8.09	4.04	2.06	0.73	0.01	<0.01	0	0	13.12	8.71	6.77	4.31	10.30	6.84	5.33	3.61
	North Atlantic right whale[d] (migrating)	4.84	1.98	0.96	0.21	<0.01	0	0	0	10.32	6.70	5.27	3.10	23.37	17.55	14.52	10.91
	Sei whale[d]	0.27	0.15	0.09	0.04	<0.01	<0.01	0	0	0.41	0.29	0.24	0.17	0.36	0.24	0.18	0.12
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.18	0.09	<0.01	0	0	0	0	0	361.98	248.68	205.51	134.92	200.97	140.06	101.36	62.92
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	52.81	22.73	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1179.39	119.85	0	0	934.40	475.79	297.25	135.57
	Bottlenose dolphin, offshore	8.83	0	0	0	0	0	0	0	7828.68	5274.70	4160.77	2497.15	4299.74	2909.34	2065.77	1278.24
	Risso's dolphin	0.01	<0.01	<0.01	0	<0.01	0	0	0	14.75	10.32	8.59	5.93	8.54	5.97	4.41	2.82
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	101.24	55.99	31.10	7.73	10.35	3.20	0.80	0.29	174.41	120.72	98.29	65.65	616.63	484.11	404.91	317.88
PPW	Gray seal	4.41	1.30	0.26	<0.01	0.02	0	0	0	23.93	14.76	11.78	7.60	17.41	11.03	8.54	5.17
	Harbor seal	10.63	3.07	0.90	0.09	0.08	<0.01	0	0	55.58	35.06	26.64	16.88	40.06	25.65	19.52	12.16

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table 25. Construction Schedule 2, year 2 – Full Buildout: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)[d]								Attenuation (dB)[d]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	27.56	15.65	9.29	4.06	0.05	0.02	0	0	41.41	29.70	24.78	17.23	36.54	24.21	18.53	12.75
	Minke whale	24.48	9.99	3.73	0.68	0.02	<0.01	0	0	54.88	39.46	32.09	21.58	39.33	27.57	22.31	15.87
	Humpback whale	6.23	3.12	1.60	0.57	<0.01	<0.01	0	0	10.09	6.70	5.21	3.33	7.92	5.26	4.10	2.78
	North Atlantic right whale[c] (migrating)	2.63	1.08	0.53	0.12	<0.01	0	0	0	5.60	3.63	2.86	1.69	12.65	9.50	7.87	5.91
	Sei whale[c]	0.20	0.11	0.07	0.03	<0.01	<0.01	0	0	0.30	0.21	0.18	0.12	0.26	0.17	0.13	0.09
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.14	0.07	<0.01	0	0	0	0	0	276.85	190.33	157.05	103.53	153.82	107.16	77.69	48.27
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	42.36	18.24	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1007.92	111.68	0	0	800.77	405.83	254.45	116.08
	Bottlenose dolphin, offshore	7.65	0	0	0	0	0	0	0	6634.41	4471.85	3525.79	2121.42	3644.52	2467.09	1752.99	1086.06
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	12.68	8.88	7.38	5.10	7.35	5.13	3.79	2.43
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	66.75	36.93	20.53	5.12	6.83	2.12	0.53	0.19	114.95	79.57	64.77	43.29	406.30	319.00	266.82	209.47
PPW	Gray seal	2.86	0.86	0.18	<0.01	0.01	0	0	0	15.40	9.50	7.55	4.91	11.19	7.09	5.50	3.34
	Harbor seal	6.90	2.02	0.60	0.06	0.05	<0.01	0	0	35.75	22.57	17.08	10.92	25.76	16.49	12.55	7.83

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

Table 26. Construction Schedule 2, years 1 and 2 combined – Full Buildout: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)[d]								Attenuation (dB)[d]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	61.67	34.98	20.74	9.04	0.11	0.05	0	0	92.67	66.48	55.50	38.52	81.77	54.17	41.46	28.51
	Minke whale	56.41	22.92	8.51	1.55	0.05	<0.01	0	0	126.79	91.13	74.13	49.75	90.85	63.67	51.54	36.63
	Humpback whale	14.32	7.15	3.66	1.30	0.02	<0.01	0	0	23.21	15.41	11.98	7.64	18.22	12.11	9.43	6.39
	North Atlantic right whale[c] (migrating)	7.48	3.06	1.49	0.33	<0.01	0	0	0	15.92	10.33	8.13	4.78	36.02	27.05	22.39	16.82
	Sei whale[c]	0.47	0.26	0.16	0.07	<0.01	<0.01	0	0	0.70	0.50	0.42	0.29	0.62	0.41	0.31	0.22
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.32	0.16	0.02	0	0	0	0	0	638.83	439.00	362.56	238.46	354.79	247.22	179.05	111.19
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	95.17	40.97	2.79	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	2187.31	231.53	0	0	1735.17	881.63	551.70	251.65
	Bottlenose dolphin, offshore	16.48	0	0	0	0	0	0	0	14463.09	9746.54	7686.55	4618.57	7944.26	5376.42	3818.76	2364.30
	Risso's dolphin	0.02	<0.01	<0.01	0	0.02	0	0	0	27.43	19.20	15.97	11.03	15.89	11.11	8.20	5.25
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	167.98	92.92	51.63	12.85	17.19	5.32	1.33	0.49	289.37	200.29	163.06	108.94	1022.93	803.11	671.73	527.35
PPW	Gray seal	7.27	2.16	0.44	<0.01	0.03	0	0	0	39.32	24.27	19.33	12.51	28.60	18.12	14.04	8.51
	Harbor seal	17.53	5.09	1.49	0.14	0.13	<0.01	0	0	91.33	57.63	43.73	27.80	65.82	42.15	32.08	19.99

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

6.2.5.2. Project 1 Plus Overlap

The model-predicted exposure estimates by species for Project 1 are provided in Table 27, assuming 0, 6, 10, and 15 dB broadband attenuation for year 1 of Construction Schedule 2. Year 1 impact pile driving activities are expected to occur in 2026 (see Table 7 for more detail). Based on this construction schedule, the buildout of Project 1 will be completed in one year, including the six WTG foundations installed in the Overlap Area. Therefore, no exposures are attributed to Project 1 during the second year of construction. These exposure estimates were calculated using Construction Schedule 2 for the Project 1 plus Overlap breakdown (Table 9) as described in Section 2.2, which was carried forward to the take calculations.

Table 27. Construction Schedule 2, year 1 – Project 1 plus Overlap: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

	Species	Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	34.11	19.33	11.45	4.98	0.06	0.03	0	0	51.26	36.77	30.72	21.29	45.23	29.95	22.93	15.76
	Minke whale	31.93	12.93	4.79	0.87	0.03	<0.01	0	0	71.91	51.67	42.05	28.17	51.51	36.10	29.23	20.75
	Humpback whale	8.09	4.04	2.06	0.73	0.01	<0.01	0	0	13.12	8.71	6.77	4.31	10.30	6.84	5.33	3.61
	North Atlantic right whale[d] (migrating)	4.84	1.98	0.96	0.21	<0.01	0	0	0	10.32	6.70	5.27	3.10	23.37	17.55	14.52	10.91
	Sei whale[d]	0.27	0.15	0.09	0.04	<0.01	<0.01	0	0	0.41	0.29	0.24	0.17	0.36	0.24	0.18	0.12
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.18	0.09	<0.01	0	0	0	0	0	361.98	248.68	205.51	134.92	200.97	140.06	101.36	62.92
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	52.81	22.73	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1179.39	119.85	0	0	934.40	475.79	297.25	135.57
	Bottlenose dolphin, offshore	8.83	0	0	0	0	0	0	0	7828.68	5274.70	4160.77	2497.15	4299.74	2909.34	2065.77	1278.24
	Risso's dolphin	0.01	<0.01	<0.01	0	<0.01	0	0	0	14.75	10.32	8.59	5.93	8.54	5.97	4.41	2.82
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	101.24	55.99	31.10	7.73	10.35	3.20	0.80	0.29	174.41	120.72	98.29	65.65	616.63	484.11	404.91	317.88
PPW	Gray seal	4.41	1.30	0.26	<0.01	0.02	0	0	0	23.93	14.76	11.78	7.60	17.41	11.03	8.54	5.17
	Harbor seal	10.63	3.07	0.90	0.09	0.08	<0.01	0	0	55.58	35.06	26.64	16.88	40.06	25.65	19.52	12.16

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

6.2.5.3. Project 2 Plus Overlap

The model-predicted exposure estimates by species for Project 2 are provided in 28–30, assuming 0, 6, 10, and 15 dB broadband attenuation for year 1 and year 2 of Construction Schedule 2 as well as for both years combined. Year 1 and year 2 for impact pile driving activities are expected to occur in 2026 and 2027 (see Table 7 for more detail). Year 1 exposures are based on installation of the six WTG foundations in the Overlap Area and year 2 exposures are based on installation of the remainder of the foundations for Project 2. These exposure estimates are calculated using Construction Schedule 2 for the Project 2 plus Overlap breakdown (Table 10) as described in Section 2.2, which was carried forward to the take calculations.

Table 28. Construction Schedule 2, year 1 – Project 2 plus Overlap: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		**Injury**								**Behavior**							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	0.93	0.52	0.31	0.13	<0.01	<0.01	0	0	1.40	1.00	0.84	0.58	1.23	0.81	0.63	0.43
	Minke whale	0.73	0.29	0.10	0.02	<0.01	0	0	0	1.66	1.19	0.97	0.64	1.19	0.83	0.68	0.48
	Humpback whale	0.69	0.34	0.17	0.06	<0.01	0	0	0	1.13	0.75	0.58	0.37	0.88	0.59	0.46	0.31
	North Atlantic right whale[d] (migrating)	1.69	0.69	0.33	0.07	<0.01	0	0	0	3.61	2.34	1.85	1.08	8.19	6.15	5.09	3.82
	Sei whale[d]	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0	0	0.03	0.02	0.02	0.01	0.02	0.02	0.01	<0.01
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.01	<0.01	0	0	0	0	0	0	28.04	19.22	15.96	10.34	15.53	10.84	7.80	4.82
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	5.22	2.24	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	17.72	0.84	0	0	13.81	7.23	4.42	2.01
	Bottlenose dolphin, offshore	0.13	0	0	0	0	0	0	0	131.18	88.18	69.75	41.27	71.97	48.58	34.36	21.11
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	0.27	0.19	0.16	0.11	0.15	0.11	0.08	0.05
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	58.36	32.26	17.88	4.41	5.96	1.84	0.45	0.17	100.62	69.64	56.73	37.83	355.94	279.42	233.69	183.44
PPW	Gray seal	0.94	0.27	0.05	0	<0.01	0	0	0	5.19	3.20	2.57	1.63	3.78	2.40	1.85	1.12
	Harbor seal	2.27	0.63	0.18	0.02	0.02	0	0	0	12.06	7.60	5.81	3.63	8.69	5.57	4.24	2.63

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table 29. Construction Schedule 2, year 2 – Project 2 plus Overlap: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)[d]								Attenuation (dB)[d]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	27.56	15.65	9.29	4.06	0.05	0.02	0	0	41.41	29.70	24.78	17.23	36.54	24.21	18.53	12.75
	Minke whale	24.48	9.99	3.73	0.68	0.02	<0.01	0	0	54.88	39.46	32.09	21.58	39.33	27.57	22.31	15.87
	Humpback whale	6.23	3.12	1.60	0.57	<0.01	<0.01	0	0	10.09	6.70	5.21	3.33	7.92	5.26	4.10	2.78
	North Atlantic right whale[c] (migrating)	2.63	1.08	0.53	0.12	<0.01	0	0	0	5.60	3.63	2.86	1.69	12.65	9.50	7.87	5.91
	Sei whale[c]	0.20	0.11	0.07	0.03	<0.01	<0.01	0	0	0.30	0.21	0.18	0.12	0.26	0.17	0.13	0.09
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.14	0.07	<0.01	0	0	0	0	0	276.85	190.33	157.05	103.53	153.82	107.16	77.69	48.27
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	42.36	18.24	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1007.92	111.68	0	0	800.77	405.83	254.45	116.08
	Bottlenose dolphin, offshore	7.65	0	0	0	0	0	0	0	6634.41	4471.85	3525.79	2121.42	3644.52	2467.09	1752.99	1086.06
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	12.68	8.88	7.38	5.10	7.35	5.13	3.79	2.43
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	66.75	36.93	20.53	5.12	6.83	2.12	0.53	0.19	114.95	79.57	64.77	43.29	406.30	319.00	266.82	209.47
PPW	Gray seal	2.86	0.86	0.18	<0.01	0.01	0	0	0	15.40	9.50	7.55	4.91	11.19	7.09	5.50	3.34
	Harbor seal	6.90	2.02	0.60	0.06	0.05	<0.01	0	0	35.75	22.57	17.08	10.92	25.76	16.49	12.55	7.83

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

Table 30. Construction Schedule 2, years 1 and 2 combined – Project 2 plus Overlap: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 2 assumes all WTGs and the met tower are installed on jacket foundations each with four 5-m pin piles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB)[d]								Attenuation (dB)[d]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	28.49	16.17	9.59	4.19	0.05	0.02	0	0	42.80	30.71	25.63	17.81	37.77	25.03	19.15	13.17
	Minke whale	25.21	10.27	3.83	0.70	0.02	<0.01	0	0	56.55	40.65	33.06	22.23	40.52	28.41	22.98	16.35
	Humpback whale	6.92	3.46	1.77	0.63	<0.01	<0.01	0	0	11.22	7.45	5.79	3.69	8.81	5.85	4.56	3.09
	North Atlantic right whale[c] (migrating)	4.32	1.77	0.86	0.19	<0.01	0	0	0	9.21	5.98	4.70	2.77	20.85	15.65	12.96	9.73
	Sei whale[c]	0.22	0.12	0.07	0.03	<0.01	<0.01	0	0	0.32	0.23	0.19	0.13	0.29	0.19	0.15	0.10
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.15	0.08	<0.01	0	0	0	0	0	304.89	209.55	173.01	113.87	169.35	118.00	85.48	53.09
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	47.57	20.48	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1025.64	112.53	0	0	814.58	413.06	258.87	118.09
	Bottlenose dolphin, offshore	7.78	0	0	0	0	0	0	0	6765.59	4560.03	3595.53	2162.69	3716.49	2515.66	1787.34	1107.17
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	12.95	9.06	7.54	5.21	7.50	5.24	3.87	2.48
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	125.11	69.19	38.42	9.53	12.79	3.95	0.98	0.36	215.58	149.20	121.49	81.12	762.24	598.42	500.51	392.92
PPW	Gray seal	3.80	1.13	0.23	<0.01	0.02	0	0	0	20.58	12.70	10.12	6.54	14.97	9.49	7.35	4.45
	Harbor seal	9.17	2.66	0.78	0.07	0.07	<0.01	0	0	47.81	30.17	22.90	14.55	34.46	22.06	16.79	10.46

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Listed as Endangered under the ESA.

[d] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

6.3. Exposure Estimation – Vibratory Pile Driving for Cofferdam Installation and Removal

Atlantic Shores is requesting Level B take resulting from the sound generated during vibratory pile driving of cofferdams at two cable landing sites: Monmouth and Atlantic. Atlantic Shores assumes that there will be no Level A takes because of the short ranges to the Level A harassment thresholds, mitigation measures to be implemented, and the animals' behavior, which makes it unlikely that they would remain within the Level A SEL range for the duration of time it would take to reach the SEL threshold. As the exact installation schedule is unknown, Atlantic Shores assumes that all cofferdams would be installed and removed at the Atlantic City landfall site in 2025 (8 days of installation and 8 days of removal for a total of 16 days) and at the Monmouth landfall site in 2026 (8 days of installation and 8 days of removal for a total of 16 days). It is possible that all cofferdam installation/removal could occur in 2025 (total of 32 days for both sites); however, this would not alter the total number of exposures estimated for cofferdam installation/removal but would shift the associated takes to 2025, would result in zero takes for this activity in 2026 and fewer takes overall in 2026.

6.3.1. Source and Propagation Modeling

The source spectrum used for vibratory pile driving was based on measured data (Illingworth & Rodkin, 2017; see Appendix D). JASCO's Marine Operations Noise Model (MONM) was used to predict SEL and SPL sound fields at a representative location near the proposed cofferdam sites considering the influence of bathymetry, seabed, water sound speed, and water attenuation. The sheet pile was represented as a point source at 2 m depth, and total sound energy transmission loss was computed at the center frequencies of decidecade bands as a function of range and depth from the source. The acoustic field in three dimensions was generated by modeling 2-D vertical planes radially spaced at 2.5° in a 360° swath around the source (*N*×2-D). Composite broadband received SEL was computed by summing the received decidecade band levels across frequency and taking the maximum-over-depth. See Appendix D for additional details.

The resulting acoustic ranges to the 120 dB Level B threshold using the winter sound speed profile were ~7.5 km at the Atlantic site and 11.3 km at the Monmouth site. Acoustic ranges to the Level A SEL threshold were all 70 m or less, except for high-frequency cetaceans (the harbor porpoise), for which the longest range was 585 m at the Atlantic site. See Appendix D for details.

6.3.2. Exposure Estimates – Vibratory Pile Driving for Cofferdam Installation and Removal

Exposures were estimated using a ZOI around each modeling site. The ZOI is a representation of the maximum extent of the ensonified area around a sound source over a 24-hour period and is expressed in units of meters squared. The ZOI was calculated for each of the two locations (Atlantic and Monmouth) and for both Level A and Level B. The ZOI for stationary sources is a circle centered on the source location, with a radius equal to the maximum acoustic range to threshold ($R_{95\%}$). Because the sources were located along the coastline, the ZOI area was partially on land. To correct for this, the ZOI was clipped by the coastline so that land areas were not included in the exposure calculation:

$$\mathrm{ZOI} = \pi r^2 - A_{land} \ , \tag{2}$$

where r is the acoustic range to threshold for the metric of interest and A_{land} is the portion of the circle that is over land. Exposures above Level A and B acoustic thresholds at each site were estimated at each location and for all species using:

$$\mathrm{Exposures} = \mathrm{ZOI} \times (\mathrm{days}) \times \mathrm{density} \, , \tag{3}$$

where ZOI is defined in Equation 2, days = 8, and density is from Table 13. An annual maximum exposure was calculated, conservatively assuming that cofferdam installation/removal will occur during winter months only. The resulting maximum yearly exposures for all cofferdam installation and removal activities are provided in Table 31.

Table 31. Vibratory pile driving for cofferdam installation and removal, Level A: maximum estimated exposures above the Level A acoustic criterion from cofferdam installation and removal during Years 1 and 2. The vibratory sheet pile driving activities are expected to occur during a single year.

Species		Year 1 (Atlantic)	Year 2 (Monmouth)	Maximum total exposures
LF	Fin whale[a]	<0.01	<0.01	<0.01
	Minke whale	<0.01	<0.01	<0.01
	Humpback whale	<0.01	<0.01	<0.01
	North Atlantic right whale[a]	<0.01	<0.01	<0.01
	Sei whale[a]	<0.01	<0.01	<0.01
MF	Atlantic spotted dolphin	0	0	0
	Atlantic white-sided dolphin	0	0	0
	Short-beaked common dolphin	0	0	0
	Bottlenose dolphin, coastal	0	0	0
	Bottlenose dolphin, offshore	0	0	0
	Risso's dolphin	0	0	0
	Pilot whale, long-finned	0	0	0
	Pilot whale, short-finned	0	0	0
	Sperm whale[a]	0	0	0
HF	Harbor porpoise	0.40	0.79	1.19
PPW	Gray seal	<0.01	<0.01	<0.01
	Harbor seal	<0.01	<0.01	<0.01

[a] Listed as Endangered under the ESA.

Table 32. Vibratory pile driving for cofferdam installation and removal, Level B: maximum estimated exposures above the Level B acoustic criterion from cofferdam installation and removal during Years 1 and 2. The vibratory sheet pile driving activities are expected to occur during a single year.

Species		Year 1 (Atlantic)	Year 2 (Monmouth)	Maximum total exposures
LF	Fin whale[a]	0.77	2.58	3.35
	Minke whale	0.16	0.49	0.65
	Humpback whale	2.81	4.32	7.13
	North Atlantic right whale[a]	2.23	5.02	7.25
	Sei whale[a]	0.01	0.16	0.17
MF	Atlantic spotted dolphin	0.06	0.58	0.64
	Atlantic white-sided dolphin	1.09	4.74	5.83
	Short-beaked common dolphin	10.96	63.75	74.71
	Bottlenose dolphin, coastal	980.53	471.78	1452.31
	Bottlenose dolphin, offshore	0	0	0
	Risso's dolphin	<0.01	0.02	0.03
	Pilot whale, long-finned	0.02	0.10	0.12
	Pilot whale, short-finned	0.02	0.07	0.09
	Sperm whale[a]	0.02	0.14	0.16
HF	Harbor porpoise	46.91	276.64	323.55
PPW	Gray seal	70.67	187.06	257.73
	Harbor seal	158.79	420.28	579.07

[a] Listed as Endangered under the ESA.

6.4. Exposure Estimation – HRG Surveys

Atlantic Shores is requesting Level B take for HRG surveys required to support the site characterization, siting, and engineering design of the offshore Projects' facilities including WTGs, OSS, and export cables within an approximately 589,511-acre survey area that extends from the New Jersey coastline from approximately Wall Township to Atlantic City and out to approximately 24 nautical miles (~44.5 km). Take estimates for the HRG surveys were calculated on behalf of Atlantic Shores by Environmental Design & Research (EDR). The full EDR technical memo is provided in Appendix C. Exposure estimate calculations are summarized in Section 6.4.1, exposures estimates are shown in Section 6.4.2, and the take estimates calculated using these exposure estimates are provided in Section 6.5.2. Figure 1 in Appendix C depicts the proposed survey area.

6.4.1. Rationale and Assumptions

Horizonal distances to the Level B acoustic threshold for various types of HRG survey equipment were calculated on behalf of Atlantic Shores by Environmental Design & Research (see Table 2 in Appendix C). The maximum distance of the representative equipment types was used in the take calculations. This distance was associated with the Applied Acoustic Dura-Spark 240 with a range to the 160 dB threshold of 141 m. This range was used to calculate the ZOI for a mobile receiver based on the following equation where *r* is the range to the Level B threshold and where distance per day is assumed to be 55 km:

$$\mathrm{ZOI} = \left(2r\,\frac{\mathrm{distance}}{\mathrm{day}}\right) + \,\pi r^2 \quad , \tag{4}$$

The resulting ZOI was 15.57 km^2 (see Appendix C for additional details).

Density-based estimates of potential marine mammal exposures to HRG survey sounds above the Level B threshold criterion were calculated using maximum seasonal average densities calculated from Roberts et al. (2016a, 2016b, 2017, 2018, 2021a, 2021b). Habitat-based density models were prepared in accordance with the methodology described in Section 6.1.1.2, and the ZOI was calculated based on the longest range to the Level B acoustic threshold as described above. Exposure estimation for HRG surveys was calculated based on the following equation where *D* is the maximum average density for each species as calculated in Section 6.1.1.2, ZOI is the zone of influence obtained from Equation (4), and *d* = 60, the presumed number of survey days per year:

$$\mathit{Estimated\ exposures} = D \times \mathrm{ZOI} \times d \tag{5}$$

Additional details on HRG exposure estimation are provided in Appendix B. In estimating total maximum take, was Atlantic Shores assumed that there would be 60 days of HRG surveys during each of the 5 years covered by this LOA request.

6.4.2. Exposure Estimates – HRG Surveys

The maximum yearly and maximum total estimates of marine mammal exposures above the Level B threshold criterion using the conservative assumptions described in Section 6.4.1 and Appendix C are provided in Table 33. The maximum total exposures are for all 5 years of HRG surveys and for the full buildout.

Table 33. Maximum yearly and maximum total estimated exposures above the Level B acoustic criterion from HRG surveys.

Species		Maximum yearly exposures	Maximum total exposures for all 5 years of surveys
LF	Fin whale[a]	1	5
	Minke whale	1	5
	Humpback whale	1	5
	North Atlantic right whale[a]	3	15
	Sei whale[a]	1	5
MF	Atlantic spotted dolphin	1	5
	Atlantic white-sided dolphin	3	15
	Short-beaked common dolphin	21	105
	Bottlenose dolphin, coastal	90	450
	Bottlenose dolphin, offshore	182	910
	Risso's dolphin	1	5
	Pilot whale, long-finned	1	5
	Pilot whale, short-finned[b]	0	0
	Sperm whale[a]	1	5
HF	Harbor porpoise	29	145
PPW	Gray seal	41	205
	Harbor seal	41	205

[a] Listed as Endangered under the ESA.

[b] No short-finned pilot whale exposures are anticipated from HRG surveys.

6.5. Marine Mammal Take Calculations

6.5.1. Take Estimates – Impact Pile Driving

For this LOA request, the take estimates for modeled marine mammal species assume 10 dB sound attenuation as a level that Atlantic Shores is committed to achieving. Predicted exposures with 10 dB broadband sound attenuation for each species and each year from Construction Schedule 2 were used to calculate yearly takes, and predicted exposures for Construction Schedule 2 years 1 and 2 combined were used to calculate total takes for impact pile driving associated with the Full Buildout. Takes were calculated by selecting the higher of the SEL and PK value for Level A and the NOAA (2005) value for Level B. Each of these were rounded up to a whole number. For Level B, a group size correction was applied for estimates lower than one mean group size (see Section 6.1.2). The assumptions used for the construction schedules are summarized in Section 2.2 and take calculation methods and assumptions for impact pile driving are described in Sections 6.2.1–6.2.3. It was assumed that pile installation would begin in Year 2 of the period covered by this LOA request, so the takes shown below are for Year 2 and Year 3. The total take estimates are based on predicted exposures from the exposure modeling for years 1 and 2 combined, and therefore total takes estimates are not the sum of the individual years.

For this LOA request, correction for one mean group size per year was applied to Level B take estimates for impact pile driving for sei, sperm, and long- and short-finned pilot whales and for Atlantic spotted, Risso's, and bottlenose (Northern Coastal Stock) dolphins for each year and for the total Project. In Year 2, correction for mean group size was also applied to NARW (increased from 3 to 4 animals exposed at the Level B threshold). Because pile driving for the Projects will occur over a period of 2 years, the mean group size rule applied to the annual take estimates was doubled to two mean group sizes to obtain the total take estimates for the entire construction schedule to account for the possibility that a group exposure could occur in each of the two years. In all other cases, except for common dolphins, the Level B take as calculated from the animal movement modeling exposure estimates using the 160 dB SPL criteria exceeded the mean group size for the species, so no adjustment for group size was made.

Take estimates for short-beaked common dolphins are based on the average daily sighting rate from Atlantic Shores currently active IHA for site characterization surveys (NOAA Fisheries 2022), informed by previous site characterization surveys in the area. The average daily sighting rate of 1.55 common dolphins was multiplied by the number of pile driving days for each year and for the total buildout of the Projects. This approach assumes that the average daily sighting rate occurs within their Level B zone per pile driving day, as described in Section 6.1.2.

Although the exposure estimates shown in Tables 24–26 suggest that Level A harassment of NARW is a possibility, incorporation of special mitigation measures designed to protect this species will ensure that no NARW is exposed to sounds above the Level A thresholds. Thus, the yearly and total take estimates for this species for Level A harassment were lowered to zero in all take tables, and no Level A takes of NARW are requested.

6.5.1.1. Full Buildout

Table 34. Level A and Level B take estimates for impact pile driving – Full Buildout.

Species		Stock Size	Year 2[e]			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	12	31	0.63	10	25	0.51	21	56	1.13
	Minke whale	21968	5	43	0.22	4	33	0.17	9	75	0.38
	Humpback whale	1396	3	7	0.72	2	6	0.57	4	12	1.15
	North Atlantic right whale[a]	368	0	6	1.63	0	4[b]	1.09	0	9	2.99
	Sei whale[a]	6292	1	3[b]	0.06	1	3[b]	0.06	1	6[b]	0.11
MF	Atlantic spotted dolphin	39921	0	100[b]	0.25	0	100[b]	0.25	0	200[b]	0.50
	Atlantic white-sided dolphin	93233	1	206	0.22	1	158	0.17	1	363	0.39
	Short-beaked common dolphin[c]	172974	0	193	0.11	0	157	0.09	0	349	0.20
	Bottlenose dolphin, coastal	6639	0	14[b]	0.21	0	14[b]	0.21	0	28[b]	0.42
	Bottlenose dolphin, offshore	62851	0	4161	6.62	0	3526	5.61	0	7687	12.23
	Risso's dolphin	35215	1	30[b]	0.09	1	30[b]	0.09	1	60[b]	0.17
	Long-finned pilot whale	39215	0	20[b]	0.02	0	20[b]	0.02	0	40[b]	0.10
	Short-finned pilot whale	28924	0	6[b]	0.02	0	6[b]	0.02	0	12[b]	0.04
	Sperm whale[a]	4349	0	2[b]	0.05	0	2[b]	0.05	0	4[b]	0.09
HF	Harbor porpoise	95543	32	99	0.14	21	65	0.09	52	164	0.23
PPW	Gray seal	27300	1	12	0.05	1	8	0.03	1	20	0.08
	Harbor seal	61336	1	27	0.05	1	18	0.03	2	44	0.07

[a] Listed as Endangered under the ESA.

[b] Take estimate rounded up to one average group size for yearly take and to two average group sizes for total take estimates.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[e] Year 2 and Year 3 are expected to be in 2026 and 2027 for impact pile driving activities.

6.5.1.2. Project 1 Plus Overlap

Table 35. Level A and Level B take estimates for impact pile driving – Project 1 plus Overlap.

Species		Stock Size	Year 2[e]			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	12	31	0.63	0	0	0	12	31	0.63
	Minke whale	21968	5	43	0.22	0	0	0	5	43	0.22
	Humpback whale	1396	3	7	0.72	0	0	0	3	7	0.72
	North Atlantic right whale[a,b]	368	0	6	1.63	0	0	0	0	6	1.63
	Sei whale[a,b]	6292	1	3	0.06	0	0	0	1	3	0.06
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	0	0	0	100	0.25
	Atlantic white-sided dolphin	93233	1	206	0.22	0	0	0	1	206	0.22
	Short-beaked common dolphin[c]	172974	0	193	0.11	0	0	0	0	193	0.11
	Bottlenose dolphin, coastal[b]	6639	0	14	0.21	0	0	0	0	14	0.21
	Bottlenose dolphin, offshore	62851	0	4161	6.62	0	0	0	0	4161	6.62
	Risso's dolphin[b]	35215	1	30	0.09	0	0	0	1	30	0.09
	Long-finned pilot whale[b]	39215	0	20	0.05	0	0	0	0	20	0.05
	Short-finned pilot whale[b]	28924	0	6	0.02	0	0	0	0	6	0.02
	Sperm whale[a,b]	4349	0	2	0.05	0	0	0	0	2	0.05
HF	Harbor porpoise	95543	32	99	0.14	0	0	0	32	99	0.14
PPW	Gray seal	27300	1	12	0.05	0	0	0	1	12	0.05
	Harbor seal	61336	1	27	0.05	0	0	0	1	27	0.05

[a] Listed as Endangered under the ESA.

[b] Take estimate rounded up to one average group size for yearly take and to two average group sizes for total take estimates.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[e] Year 2 and Year 3 are expected to be in 2026 and 2027 for impact pile driving activities.

6.5.1.3. Project 2 Plus Overlap

Table 36. Level A and Level B take estimates for impact pile driving – Project 2 plus Overlap.

Species		Stock Size	Year 2[e]			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	1	2	0.04	10	25	0.51	10	26	0.53
	Minke whale	21968	1	2	0.01	4	33	0.17	4	34	0.17
	Humpback whale	1396	1	2	0.21	2	6	0.57	2	6	0.57
	North Atlantic right whale[a,b]	368	0	4	1.09	0	4	1.09	0	8	2.17
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06	1	6	0.11
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25	0	200	0.50
	Atlantic white-sided dolphin	93233	0	22	0.02	1	158	0.17	1	174	0.19
	Short-beaked common dolphin[c]	172974	0	10	0.01	0	157	0.09	0	166	0.10
	Bottlenose dolphin, coastal[b]	6639	0	14	0.21	0	14	0.21	0	28	0.42
	Bottlenose dolphin, offshore	62851	0	70	0.11	0	3526	5.61	0	3596	5.72
	Risso's dolphin[b]	35215	1	30	0.09	1	30	0.09	1	60	0.17
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05	0	40	0.10
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02	0	12	0.04
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05	0	4	0.09
HF	Harbor porpoise	95543	18	57	0.08	21	65	0.09	39	122	0.17
PPW	Gray seal	27300	1	3	0.01	1	8	0.03	1	11	0.04
	Harbor seal	61336	1	6	0.01	1	18	0.03	1	23	0.04

[a] Listed as Endangered under the ESA.

[b] Take estimates rounded up to one average group size for Year 3 and to two average group sizes for total take estimates. For Year 2 take, because of the limit amount of pile driving, takes for all species except offshore bottlenose dolphins, harbor porpoise, and seals were estimated as zero. As a conservative measure, takes for the other species were rounded up to one average group size.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[e] Year 2 and Year 3 are expected to be in 2026 and 2027 for impact pile driving activities.

6.5.2. Take Estimates – Vibratory Pile Driving for Cofferdam Installation and Removal

Take estimates for vibratory pile driving for cofferdam installation and removal are based on the exposure estimates provided in Section 6.3.2 and are adjusted for some species by average group size as described in Section 6.1.2. Table 37 includes the requested Level B takes resulting from vibratory pile driving for the Projects. Takes from vibratory pile driving are requested for Years 1 and 2. Cofferdam installation/removal activities are expected to occur in 2025 and/or 2026. As the exact schedule is unknown, Atlantic Shores assumed that all cofferdams would be installed and removed at the Atlantic landfall site in 2025 (8 days of installation and 8 days of removal for a total of 16 days) and at the Monmouth landfall site in 2026 (8 days of installation and 8 days of removal for a total of 16 days). This provides a reasonable estimate of the maximum yearly takes from all activities for 2026, because most exposure estimates for cofferdam installation at the Monmouth landfall site are greater than at the Atlantic landfall site and because the estimated takes from impact pile driving are highest for 2026. It is possible that all cofferdam installation/removal could occur in 2025 (total of 32 days for both sites); however, this would not alter the total number of takes for cofferdam installation/removal but would shift the associated takes to 2025, would result in zero takes for this activity in 2026 and fewer takes overall in 2026. The mitigation measures detailed in Section 11 were not considered when predicting harassment, except for the NARW, for which special mitigation will be applied to reduce potential Level B harassment and to eliminate Level A harassment entirely. Many of these measures will also reduce harassment of other marine mammal species. Level A harassment for other species is unlikely given the short ranges to the Level A thresholds, the proposed mitigation measures, and the behavior of the animals that make it unlikely that they would remain within the predicted SEL range of the activity for the time required to induce PTS onset.

For the Project 1 and Project 2 breakdown, as a conservative measure, the estimated takes for cofferdam installation/removal at the Monmouth landfall site were used for both projects because these are higher for most species. For Project 1, it was assumed these takes would occur in Year 1 (expected to be 2025) and for Project 2 it was assumed these takes would occur in Year 2 (expected to be 2026).

Table 37. Yearly and total Level B take estimates for vibratory pile driving from cofferdam installation and removal.

Species		Year 1[e]	Year 2	Total
LF	Fin whale[a]	2 [b]	3	5 [b]
	Minke whale	2 [b]	2 [b]	4 [b]
	Humpback whale	3	5	8
	North Atlantic right whale[a]	4 [b]	6	10 [b]
	Sei whale[a]	3 [b]	3 [b]	6 [b]
MF	Atlantic spotted dolphin	100 [b]	100 [b]	200 [b]
	Atlantic white-sided dolphin	22 [b]	22 [b]	44 [b]
	Short-beaked common dolphin [c]	25	25	50
	Bottlenose dolphin, coastal	981	472	1453
	Bottlenose dolphin, offshore	0	0	0
	Risso's dolphin	30 [b]	30 [b]	60 [b]
	Long-finned pilot whale	20 [b]	20 [b]	40 [b]
	Short-finned pilot whale	6 [b]	6 [b]	12 [b]
	Sperm whale[a]	2 [b]	2 [b]	4 [b]
HF	Harbor porpoise	47	277	324
PPW	Gray seal	71	188	259
	Harbor seal	159	421	580

[a] Listed as Endangered under the ESA.

[b] Adjusted to average group size.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of survey days.

[e] Year 1 and Year 2 are expected to be in 2025 and 2026 for vibratory pile driving cofferdam activities.

6.5.3. Take Estimates – HRG Surveys

Take estimates for HRG surveys are based on the exposure estimates provided in Section 6.4.2, which were adjusted for some species by average group size, as described in Section 6.1.2. To obtain take estimates, exposures were corrected upward by the species average group size for long-finned pilot whales, Atlantic spotted dolphins, and Risso's dolphins. For short-beaked common dolphins, estimated exposures used the average daily sighting rate from previous site characterization surveys conducted by Atlantic shores in the area (i.e., 1.55 common dolphins per day) multiplied by the number of survey days. Yearly exposures were rounded up to an integer to get estimated takes. Yearly takes were multiplied by 5 to get the maximum total Level B takes for the full buildout.

6.5.3.1. Full Buildout

Take estimates from HRG surveys for the full project buildout by year and for all 5 years are shown in Table 38.

Table 38. Maximum yearly and maximum total Level B takes calculated for HRG surveys.

Species		Maximum yearly Level B takes	Maximum total Level B takes	Maximum % of population take requested annually
LF	Fin whale[a]	1	5	0.01
	Minke whale	1	5	<0.01
	Humpback whale	1	5	0.06
	North Atlantic right whale[a]	3	15	0.79
	Sei whale[a]	2	10	<0.01
MF	Atlantic spotted dolphin	100[c]	500[c]	0.25
	Atlantic white-sided dolphin	3	15	<0.01
	Short-beaked common dolphin	93	465[d]	0.13
	Bottlenose dolphin, coastal	90	450	1.36
	Bottlenose dolphin, offshore	182	910	0.29
	Risso''s dolphin	30[c]	150[c]	0.09
	Pilot whale, long-finned	20[c]	100[c]	0.05
	Pilot whale, short-finned[b]	0	0	0
	Sperm whale[a]	1	5	<0.01
HF	Harbor porpoise	29	145	0.03
PPW	Gray seal	41	205	0.15
	Harbor seal	41	205	0.15

[a] Listed as Endangered under the ESA.
[b] No short-finned pilot whale takes are anticipated.
[c] Take estimate for HRG surveys for this species was rounded up to one group size.
[d] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of survey days.

6.5.3.2. Project 1 and Project 2

The take estimates for the two projects were based on a 50/50 split of the total buildout takes because the proposed HRG surveys will benefit both projects equally. When the estimated take for the full buildout was an odd number, resulting in a take value that included one half of an animal, the higher number was assigned to Project 1 (i.e., decimal of .5 rounded up for Project 1 and rounded down for Project 2), but the total take number does not change. Tables 39 and 40 show the takes estimates from HRG surveys for Project 1 and Project 2, respectively.

Table 39. Maximum yearly and maximum total Level B takes for HRG surveys – Project 1.

Species		Maximum yearly Level B takes	Maximum total Level B takes
LF	Fin whale[a]	1	5
	Minke whale	1	5
	Humpback whale	1	5
	North Atlantic right whale[a]	2	10
	Sei whale[a]	1	5
MF	Atlantic spotted dolphin	50[c]	250[c]
	Atlantic white-sided dolphin	2	10
	Short-beaked common dolphin	47[d]	235[d]
	Bottlenose dolphin, coastal	45	225
	Bottlenose dolphin, offshore	91	455
	Risso''s dolphin	15[c]	75[c]
	Pilot whale, long-finned	10[c]	50[c]
	Pilot whale, short-finned[b]	0	0
	Sperm whale[a]	1	5
HF	Harbor porpoise	15	75
PPW	Gray seal	21	105
	Harbor seal	21	105

[a] Listed as Endangered under the ESA.
[b] No short-finned pilot whale takes are anticipated.
[c] Take estimate for HRG surveys for this species was rounded up to one group size before splitting into Project 1 and Project 2.
[d] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of survey days.

Table 40. Maximum yearly and maximum total Level B takes for HRG surveys – Project 2.

Species		Maximum yearly Level B takes	Maximum total Level B takes
LF	Fin whale[a]	0	0
	Minke whale	0	0
	Humpback whale	0	0
	North Atlantic right whale[a]	1	5
	Sei whale[a]	1	5
MF	Atlantic spotted dolphin	50[c]	250[c]
	Atlantic white-sided dolphin	1	5
	Short-beaked common dolphin	46[d]	230[d]
	Bottlenose dolphin, coastal	45	225
	Bottlenose dolphin, offshore	91	455
	Risso''s dolphin	15[c]	75[c]
	Pilot whale, long-finned	10[c]	50[c]
	Pilot whale, short-finned[b]	0	0
	Sperm whale[a]	0	0
HF	Harbor porpoise	14	70
PPW	Gray seal	20	100
	Harbor seal	20	100

[a] Listed as Endangered under the ESA.

[b] No short-finned pilot whale takes are anticipated.

[c] Take estimate for HRG surveys for this species was rounded up to one group size before splitting into Project 1 and Project 2.

[d] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of survey days.

6.6. Number of Takes Requested – All Activities

The subsections below show take requests for the full buildout of Atlantic Shores (Section 6.6.1) as well as for the breakdown into Project 1 plus Overlap (Section 6.6.2) and Project 2 plus Overlap (Section 6.6.3). These takes were calculated using Construction Schedule 2. For comparison, takes calculated using Schedule 1 and Schedule 3 are provided in Appendix A. The sum of the takes requested for the two projects is greater than the anticipated take for the full buildout of Atlantic Shores. This is because the requests for Project 1 and Project 2 are conservative overestimates – the takes for each project assumed that the Overlap Area as well as the more impactful of the two cofferdam locations would be included in their buildout. Although takes are conservatively estimated for Project 1 and Project 2 individually, the total takes will not exceed the take request for the Full Buildout because the Overlap Area will be used by either Project 1 or Project 2 and not both.

This application, which was deemed adequate and complete by NMFS on August 25, 2022, used density estimates that were the best available at the time that it was submitted. More recent density estimates are now available from the 2022 Duke University Marine Geospatial Ecology Laboratory (MGEL) Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016, 2022). These models include updates for all species and higher resolution density information. Updates to the density, exposure, and take estimates using the 2022 MGEL models will be provided to NMFS in an external memo no later than September 28, 2022.

6.6.1. Full Buildout

The number of takes requested for each marine mammal species per year as well as the total take request for the full buildout are provided in Tables 41 and 42, respectively. Population size is based on NMFS' 2021 draft SARs (see Table 11). The take estimates for impact pile driving are conservative in that, other than assuming 10 dB of sound attenuation, they do not account for implementation of the mitigation measures described in Section 11. For comparison, see Table 26 for estimated exposures from impact pile driving at various level of attenuation, including no attenuation. Year 1 take requests are generated from 60 days of HRG surveys and 16 days of vibratory pile driving for cofferdam installation and removal. Year 2 take requests are generated from 124 days of impact pile driving, 60 days of HRG surveys, and 16 days of vibratory pile driving. Year 3 take requests are from 101 days of impact pile driving, 16 days of vibratory pile driving for cofferdam installation and removal, and 60 days of HRG surveys. Years 3–5 take requests are from 60 days of HRG surveys each year. Note that no Level A takes are requested for NARW because specific mitigation measures will be implemented to prevent harassment of this species (see Section 11). The mitigation measures described in Section 11 will minimize Level A harassment associated with pile driving activities for all species.

Table 41. Requested Level A and Level B takes by year for all activities conducted during construction of Atlantic Shores – Full Buildout.

Species		Stock Size	Year 1[e]			Year 2			Year 3			Year 4			Year 5		
			Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]
LF	Fin whale[b]	6802	0	3[e]	0.04	12	35	0.69	10	26	0.53	0	1	0.01	0	1	0.01
	Minke whale	21968	0	3[e]	0.01	5	46[e]	0.23	4	34	0.17	0	1	<0.01	0	1	<0.01
	Humpback whale	1396	0	4	0.29	3	13	1.15	2	7	0.64	0	1	0.07	0	1	0.07
	North Atlantic right whale[b]	368	0	7[e]	1.90	0	15	4.08	0	7[c]	1.90	0	3	0.82	0	3	0.82
	Sei whale[b]	6292	0	5[e]	0.08	1	8[c,e]	0.14	1	5[c]	0.10	0	2	0.03	0	2	0.03
MF	Atlantic spotted dolphin	39921	0	200[d,e]	0.50	0	300[c,d,e]	0.75	0	200[c,d]	0.50	0	100[d]	0.25	0	100[d]	0.25
	Atlantic white-sided dolphin	93233	0	25[e]	0.03	1	231[e]	0.25	1	161	0.17	0	3	<0.01	0	3	<0.01
	Short-beaked common dolphin[f]	172974	0	118	0.07	0	311	0.18	0	250	0.14	0	93	0.05	0	93	0.05
	Bottlenose dolphin, coastal	6639	0	1071	16.13	0	576[c]	8.68	0	104[c]	1.57	0	90	1.36	0	90	1.36
	Bottlenose dolphin, offshore	62851	0	182	0.29	0	4343	6.91	0	3708	5.90	0	182	0.29	0	182	0.29
	Risso's dolphin	35215	0	60[d,e]	0.17	1	90[c,d,e]	0.26	1	60[c,d]	0.17	0	30[d]	0.09	0	30[d]	0.09
	Long-finned pilot whale	39215	0	40[d,e]	0.10	0	60[c,d,e]	0.15	0	40[c,d]	0.10	0	20[d]	0.05	0	20[d]	0.05
	Short-finned pilot whale	28924	0	6[e]	0.02	0	12[c,e]	0.04	0	6[c]	0.02	0	0	0	0	0	0
	Sperm whale[b]	4349	0	3[e]	0.07	0	5[c,e]	0.11	0	3[c]	0.07	0	1	0.02	0	1	0.02
HF	Harbor porpoise	95543	0	76	0.08	32	405	0.46	21	94	0.12	0	29	0.03	0	29	0.03
PPW	Gray seal	27300	0	112	0.41	1	241	0.89	1	49	0.18	0	41	0.15	0	41	0.15
	Harbor seal	61336	0	200	0.33	1	489	0.80	1	59	0.10	0	41	0.07	0	41	0.07

[a] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.
[b] Listed as Endangered under the ESA.
[c] Take estimate for impact pile driving rounded up to one average group size.
[d] Take estimate for HRG surveys rounded up to one group size.
[e] Take estimate for cofferdam vibratory piling rounded up to one group size.
[f] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.
[e] Years 1-5 are expected to be in 2025-2029 for HRG survey activities.

Table 42. Summary of total Level A and Level B takes for all activities conducted during construction of Atlantic Shores – Full Buildout.

Species		Stock size	5 Year total		
			Level A	Level B	Max percent[a]
LF	Fin whale[b]	6,802	21	65[e]	1.26
	Minke whale	21,968	9	83[e]	0.42
	Humpback whale	1,396	4	25	2.08
	North Atlantic right whale[b]	368	0	33[e]	8.97
	Sei whale[b]	6,292	1	21[c,e]	0.35
MF	Atlantic spotted dolphin	39,921	0	900[c,d,e]	2.25
	Atlantic white-sided dolphin	93,233	1	421[e]	0.45
	Short-beaked common dolphin[f]	172,974	0	839	0.49
	Bottlenose dolphin, coastal	6,639	0	1931[c]	29.09
	Bottlenose dolphin, offshore	62,851	0	8597	13.68
	Risso's dolphin	35,215	1	270[c,d,e]	0.77
	Long-finned pilot whale	39,215	0	180[c,d,e]	0.46
	Short-finned pilot whale	28,924	0	24[c,e]	0.08
	Sperm whale[b]	4,349	0	13[c,e]	0.30
HF	Harbor porpoise	95,543	52	633	0.72
PPW	Gray seal	27,300	1	483	1.77
	Harbor seal	61,336	2	829	1.35

[a] Max percent is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for impact pile driving rounded up to one average group size.

[d] Take estimate for HRG surveys rounded up to one group size.

[e] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

[f] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

6.6.2. Project 1 Plus Overlap

Table 43. Requested Level A and Level B takes by year for all activities conducted during construction of Atlantic Shores – Project 1 plus Overlap.

Species		Stock Size	Year 1[e]			Year 2			Year 3			Year 4			Year 5		
			Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]
LF	Fin whale[b]	6802	0	4	0.06	12	32	0.65	0	1	0.01	0	1	0.01	0	1	0.01
	Minke whale	21968	0	3	0.01	5	44	0.22	0	1	0.00	0	1	<0.01	0	1	<0.01
	Humpback whale	1396	0	6	0.43	3	8	0.79	0	1	0.07	0	1	0.07	0	1	0.07
	North Atlantic right whale[b]	368	0	8	2.17	0	8	2.17	0	2	0.54	0	2	0.54	0	2	0.54
	Sei whale[b]	6292	0	4	0.06	1	4	0.08	0	1	0.02	0	1	0.02	0	1	0.02
MF	Atlantic spotted dolphin	39921	0	150	0.38	0	150	0.38	0	50	0.13	0	50	0.13	0	50	0.13
	Atlantic white-sided dolphin	93233	0	24	0.03	1	208	0.22	0	2	0.00	0	2	<0.01	0	2	<0.01
	Short-beaked common dolphin[c]	172974	0	72	0.04	0	240	0.14	0	47	0.03	0	47	0.03	0	47	0.03
	Bottlenose dolphin, coastal	6639	0	517	7.79	0	59	0.89	0	45	0.68	0	45	0.68	0	45	0.68
	Bottlenose dolphin, offshore	62851	0	91	0.14	0	4252	6.77	0	91	0.14	0	91	0.14	0	91	0.14
	Risso’s dolphin	35215	0	45	0.13	1	45	0.13	0	15	0.04	0	15	0.04	0	15	0.04
	Long-finned pilot whale	39215	0	30	0.08	0	30	0.08	0	10	0.03	0	10	0.03	0	10	0.03
	Short-finned pilot whale	28924	0	6	0.02	0	6	0.02	0	0	0.00	0	0	0.00	0	0	0.00
	Sperm whale[b]	4349	0	3	0.07	0	3	0.07	0	1	0.02	0	1	0.02	0	1	0.02
HF	Harbor porpoise	95543	0	292	0.31	32	114	0.15	0	15	0.02	0	15	0.02	0	15	0.02
PPW	Gray seal	27300	0	209	0.77	1	33	0.12	0	21	0.08	0	21	0.08	0	21	0.08
	Harbor seal	61336	0	442	0.72	1	48	0.08	0	21	0.03	0	21	0.03	0	21	0.03

[a] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

[e] Years 1-5 are expected to be in 2025-2029 for HRG survey activities.

Table 44. Summary of total Level A and Level B takes for all activities conducted during construction of Atlantic Shores – Project 1 plus Overlap.

Species		Stock size	5 Year total		
			Level A	Level B	Max percent[a]
LF	Fin whale[b]	6802	12	39	0.75
	Minke whale	21968	5	50	0.25
	Humpback whale	1396	3	17	1.43
	North Atlantic right whale[b]	368	0	22	5.98
	Sei whale[b]	6292	1	11	0.19
MF	Atlantic spotted dolphin	39921	0	450	1.13
	Atlantic white-sided dolphin	93233	1	238	0.26
	Short-beaked common dolphin[c]	172974	0	453	0.26
	Bottlenose dolphin, coastal	6639	0	711	10.71
	Bottlenose dolphin, offshore	62851	0	4616	7.34
	Risso's dolphin	35215	1	135	0.39
	Long-finned pilot whale	39215	0	90	0.23
	Short-finned pilot whale	28924	0	12	0.04
	Sperm whale[b]	4349	0	9	0.21
HF	Harbor porpoise	95543	32	451	0.51
PPW	Gray seal	27300	1	305	1.12
	Harbor seal	61336	1	553	0.90

[a] Max percent is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[e] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

6.6.3. Project 2 Plus Overlap

Table 45. Requested Level A and Level B takes by year for all activities conducted during construction of Atlantic Shores – Project 2 plus Overlap.

Species		Stock Size	Year 1[e]			Year 2			Year 3			Year 4			Year 5		
			Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]	Level A	Level B	Max %[a]
LF	Fin whale[b]	6802	0	0	<0.01	1	5	0.09	10	25	0.51	0	0	<0.01	0	0	<0.01
	Minke whale	21968	0	0	<0.01	1	4	0.02	4	33	0.17	0	0	<0.01	0	0	<0.01
	Humpback whale	1396	0	0	<0.01	1	7	0.57	2	6	0.57	0	0	<0.01	0	0	<0.01
	North Atlantic right whale[b]	368	0	1	0.27	0	11	2.99	0	5	1.36	0	1	0.27	0	1	0.27
	Sei whale[b]	6292	0	1	0.02	1	7	0.13	1	4	0.08	0	1	0.02	0	1	0.02
MF	Atlantic spotted dolphin	39921	0	50	0.13	0	250	0.63	0	150	0.38	0	50	0.13	0	50	0.13
	Atlantic white-sided dolphin	93233	0	1	<0.01	0	45	0.05	1	159	0.17	0	1	<0.01	0	1	<0.01
	Short-beaked common dolphin[c]	172974	0	46	0.03	0	81	0.05	0	203	0.12	0	46	0.03	0	46	0.03
	Bottlenose dolphin, coastal	6639	0	45	0.68	0	531	8.00	0	59	0.89	0	45	0.68	0	45	0.68
	Bottlenose dolphin, offshore	62851	0	91	0.14	0	161	0.26	0	3617	5.75	0	91	0.14	0	91	0.14
	Risso’s dolphin	35215	0	15	0.04	1	75	0.22	1	45	0.13	0	15	0.04	0	15	0.04
	Long-finned pilot whale	39215	0	10	0.03	0	50	0.13	0	30	0.08	0	10	0.03	0	10	0.03
	Short-finned pilot whale	28924	0	0	<0.01	0	12	0.04	0	6	0.02	0	0	<0.01	0	0	<0.01
	Sperm whale[b]	4349	0	0	<0.01	0	4	0.09	0	2	0.05	0	0	<0.01	0	0	<0.01
HF	Harbor porpoise	95543	0	14	0.01	18	348	0.38	21	79	0.10	0	14	0.01	0	14	0.01
PPW	Gray seal	27300	0	20	0.07	1	211	0.78	1	28	0.11	0	20	0.07	0	20	0.07
	Harbor seal	61336	0	20	0.03	1	447	0.73	1	38	0.06	0	20	0.03	0	20	0.03

[a] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

[e] Years 1-5 are expected to be in 2025-2029 for HRG survey activities.

Table 46. Summary of total Level A and Level B takes for all activities conducted during construction of Atlantic Shores – Project 2 plus Overlap.

Species		Stock size	5 Year total		
			Level A	Level B	Max percent[a]
LF	Fin whale[b]	6802	10	29	0.57
	Minke whale	21968	4	36	0.18
	Humpback whale	1396	2	11	0.93
	North Atlantic right whale[b]	368	0	19	5.16
	Sei whale[b]	6292	1	14	0.24
MF	Atlantic spotted dolphin	39921	0	550	1.38
	Atlantic white-sided dolphin	93233	1	201	0.22
	Short-beaked common dolphin[c]	172974	0	421	0.24
	Bottlenose dolphin, coastal	6639	0	725	10.92
	Bottlenose dolphin, offshore	62851	0	4051	6.45
	Risso’s dolphin	35215	1	165	0.47
	Long-finned pilot whale	39215	0	110	0.28
	Short-finned pilot whale	28924	0	18	0.06
	Sperm whale[b]	4349	0	6	0.14
HF	Harbor porpoise	95543	39	469	0.53
PPW	Gray seal	27300	1	299	1.10
	Harbor seal	61336	1	544	0.89

[a] Max percent is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

[b] Listed as Endangered under the ESA.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of HRG survey or pile driving days.

7. Anticipated Impact of the Activity

7.1. Potential Effects of Pile Driving on Marine Mammals

Pile driving during foundation installation for the Projects could result in incidental take of marine mammals by Levels A and B harassment caused by exposure to above-threshold levels of underwater sound produced by this activity. Additional details of sounds produced by pile driving can be found in Appendix A.

Marine mammals rely on sound to carry out life-sustaining functions such as foraging, navigating, communicating, and avoiding predators. Through sound they learn about their environment by gathering information from other marine mammals, prey species, phenomena such as wind, waves, and rain, and from anthropogenic source like seismic activity (Richardson et al. 1995). The effects of sounds from pile driving could include one or more of the following: masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment (TTS or PTS), or non-auditory physical or physiological effects (Richardson et al. 1995, Nowacek et al. 2007, Southall et al. 2007). Research on the non-auditory effects of sound on marine mammals in the wild is lacking and their biological consequences unknown (Southall et al. 2007, Erbe et al. 2018). Non-auditory effects are not further considered but auditory effects are described in the following sections.

7.1.1. Masking

Masking is the obscuring of sounds of interest by interfering sounds, generally at similar frequencies. Introduced underwater sound could, through masking, reduce the effective listening area and/or communication distance of a marine mammal if the frequency of the introduced sound is close to a signal of interest to the marine mammal, and if the introduced sound is present for a significant fraction of the time (Richardson et al. 1995, Clark et al. 2009, Jensen et al. 2009, Gervaise et al. 2012, Hatch et al. 2012, Rice et al. 2014, Erbe et al. 2016b, Tennessen and Parks 2016). Conversely, if little or no overlap occurs between the introduced sound and the frequencies used by the species, masking is not expected to occur. Also, if the introduced sound is present only infrequently, masking is only expected to occur intermittently, if at all. In addition to the frequency and duration of the masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (Branstetter et al. 2013, Finneran and Branstetter 2013, Branstetter et al. 2016, Sills et al. 2017). The biological repercussions of a loss of listening area or communication space, to the extent that this occurs, are unknown.

There are few studies on the masking effects of pulsed sounds, like those related to impact pile driving, on marine mammal calls and other natural sounds that are important to marine mammals. Low-frequency cetaceans such as baleen whales are likely to be more susceptible to masking by the low-frequency noise produced by pile driving (Richardson et al. 1995). However, to date, most studies have considered impacts from a different impulsive source: seismic air guns. Some whales continue calling in the presence of seismic pulses and whale calls often can be heard between seismic pulses (Richardson et al. 1986, McDonald et al. 1995, Greene et al. 1999, Dunn and Hernandez 2009, Nieukirk et al. 2012, Thode et al. 2012, Cerchio et al. 2014, Sciacca et al. 2016). However, some of these studies found evidence of reduced calling (or at least reduced call detection rates) in the presence of seismic pulses. One report indicated that calling fin whales went silent for an extended period starting soon after the onset of a seismic survey in the area (Clark and Gagnon 2006). It is not clear from that paper if the whales ceased calling because of masking or if this was a behavioral response not directly involving masking. Also, it appeared that migrating bowhead whales (*Balaena mysticetus*) in the Beaufort Sea decreased their calling rates in response to seismic operations as evidenced by a lower call detection rate, although movement out of the area also contributed to the lower call detection rate (Blackwell et al. 2013, Blackwell et al. 2015). In contrast, Di Iorio and Clark (2009) found that blue whales in the St. Lawrence Estuary increased their call rates during operations of a lower-energy seismic source. The sparker used during that study emitted frequencies of 30–450 Hz with a relatively low source level of 193 dB re 1 µPa. There is some evidence that fin whale song notes recorded in the Mediterranean had lower bandwidths during periods with, versus without, air gun sounds (Castellote et al. 2012).

Among the odontocetes, dolphins and porpoises are commonly heard calling during pile driving (e.g. Dähne et al. 2013, Leunissen et al. 2019) and while air guns are operating (Gordon et al. 2003, Potter et al. 2007). There was one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles et al. 1994), but more recent studies found that sperm whales continue to call in the presence of seismic pulses (Madsen et al. 2002, Tyack et al. 2003, Jochens et al. 2008). In the case of the smaller odontocetes, the masking effects of pile driving are expected to be negligible because the sounds that are important to these species occur predominantly at much higher frequencies than the dominant components of pile driving sounds. For example, the harbor porpoise produces echolocation clicks of 110–150 kHz (Møhl and Andersen 1973, Teilmann et al. 2002) with source levels of 135–177 dB re 1 µPa at 1 m and the bottlenose dolphin produces echolocation clicks of 110–130 kHz with source levels of 218–228 dB re 1 µPa (reviewed by Richardson et al. 1995).

Some cetaceans are known to increase the source levels of their calls, shift their peak frequencies, or increase the repetition rate or duration of their calls in response to increased noise (reviewed in Erbe et al. 2016b). Altering vocalizations can increase energetic costs for individual marine mammals (Holt et al. 2015, Noren et al. 2017). However, it is not known how often these types of vocal responses might occur upon exposure to pile driving sounds, and thus what the biological importance of any increased costs might be. If cetaceans exposed to pile driving sounds sometimes respond by changing their vocal behavior, this adaptation, along with directional hearing and pre-adaptation to tolerate some masking by natural sounds (Richardson et al. 1995), would reduce the importance of masking by this sound source.

7.1.2. Behavioral Disturbance

Detailed data on reactions of marine mammals to anthropogenic sounds are limited to relatively few species and situations (see reviews in Richardson et al. 1995, Gordon et al. 2003, Nowacek et al. 2007, Southall et al. 2007). However, it is clear that behavioral responses to noise likely begin to occur at distances greater than those for hearing impairment or injury (see Section 6.2.2). Marine mammals' behavioral responses to noise range from subtle to conspicuous changes in behavior and movement (Southall et al. 2007). In some cases, behavioral responses to sound may result in displacement from the area, which in turn may act to reduce the overall exposure to that sound (e.g., Finneran et al. 2015, Wensveen 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, Wartzok et al. 2003, Southall et al. 2007, Ellison et al. 2012). However, if a marine mammal does react to an underwater sound by 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 (e.g., New et al. 2013).

Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of human activities and/or exposed to a particular level of anthropogenic sound (see Section 6.2.2). In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner. One reason for this is that the selected distances/isopleths are based on limited studies indicating that some animals exhibited short-term reactions at this distance or sound level, whereas the calculation assumes that all animals exposed to this level would react in a biologically significant manner. Additionally, the calculations and modeling assume numerous conservative inputs.

There is no published information available on the behavioral responses of baleen whales to impact pile driving sounds, but a number of studies have considered impacts from seismic air guns. Baleen whales generally exhibit some response to impulsive sounds from operating air guns (Stone and Tasker 2006), but avoidance radii vary greatly among species, locations, whale behavior, oceanographic conditions affecting sound propagation, etc. (see reviews in Richardson et al. 1995, Gordon et al. 2003). Whales are often reported to show no overt reactions to pulses from large arrays of air guns at distances beyond a few kilometers, even though the air gun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong sound pulses from air guns may react by moving away from and/or around the sound source, demonstrating only localized avoidance responses to operating air gun arrays (Stone and Tasker 2006, Weir 2008, Stone 2015). For example, humpback whales exposed to a 20 cubic inch air gun decreased both dive time and course changes, but there was no evidence of a strong behavioral response (Dunlop et al. 2015). Further, some migrating humpbacks showed no avoidance response at even the highest received levels 160–170 dB re 1 µPa SPL. Migrating bowhead whales, however, appear to have a stronger reaction to seismic activity, with most whales avoiding an operating seismic vessel by 20–30 km (65.6–98.4 mi) (Miller et al. 1999, Richardson et al. 1999). At this range, broadband received source levels were estimated to be 120–130 dB re 1 µPa.

Behavioral state appears to have a significant effect on the magnitude of response to air guns. Feeding bowhead whales, in contrast to migrating whales, show even 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. Similarly, resting groups of humpback whales that contained a calf were more sensitive to a 20 cubic inch air gun than those groups that were migrating (McCauley et al. 2000). In migrating bowhead and gray whales, observed changes in behavior in response to seismic activity appeared to be of little or no biological consequence to the animals as 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). Since the Offshore Project Area is not located in an important feeding area, such as the Gulf of Maine for NARW, most responses to the planned impact pile driving are expected to be more similar to those observed for migrating animals, where they simply avoided the area around the activity and continued on their migratory path, resulting in little assumed overall impact to individual animals. As with masking, because the relative time of pile driving is short, the temporal exposure when animals may interact with the acoustics from piling is also very short, further limiting the overall impact.

There are considerably more data available on the behavioral responses of odontocetes to pile driving; however, this is limited primarily to harbor porpoises as they are the most commonly detected cetacean in offshore energy development areas in the North Sea (Waggitt et al. 2020). Research in these development areas have indicated that harbor porpoises may be particularly sensitive to the noise produced during pile driving, with some animals displaced more than 20 km from piling activity (Tougaard et al. 2009, Brandt et al. 2011, Haelters et al. 2015, Dähne et al. 2017, Brandt et al. 2018). However, despite avoidance during periods of construction activity, there is typically continued use of the area after construction is completed (Madsen et al. 2006). Further, there is evidence that harbor porpoises respond less to pile driving activity over the course of a construction period, which could suggest possible habituation to this disturbance (Graham et al. 2019). Other odontocetes that have demonstrated a response to pile driving include Indo-Pacific bottlenose dolphins in Western Australia, which were less likely to be detected during piling activity (Paiva et al. 2015), and Indo-Pacific humpback dolphins, which showed no overt behavioral avoidance, but did increase travel speed during pile driving (Würsig et al. 2000).

Pinnipeds appear to also exhibit primarily short-term reactions to pile driving activity. Harbor seals exposed to piling in Denmark were observed less on land during pile driving than during time where piling was absent (Edrén et al. 2004, Edrén et al. 2010). However, it is unknown whether they were in fact displaced from the area, or whether they simply remained in the water. Seal deterrent devices were in use during pile driving, and it is also not possible to determine if the observed effect was the result of piling, the deterrent, or a combination of the two. Regardless, there was no decrease in general seal abundance during the construction period, indicating only a short-term effect (Edrén et al. 2004, Edrén et al. 2010). Grey seals appear to demonstrate primarily a decrease in descent speed during a dive, which is proposed to indicate a switch from foraging behavior to more directed horizontal movement, as well as movement away from the source (Aarts et al. 2018). Some reactions were observed at distances beyond 36 km, however some seals continued to return to the area despite the presence of piling activity. Overall, odontocete and pinniped reactions to noise from pile driving appear to be minor and temporary, and it is expected that they will result in minimal overall impacts.

7.1.3. Hearing Impairment

Exposure to sufficiently intense sound may lead to an increased hearing threshold in any living animal capable of perceiving acoustic stimuli (Finneran 2015b). If this shift is reversed and the hearing threshold returns to normal, the effect is called a temporary threshold shift (TTS). The onset of TTS is often defined as threshold shift of 6 dB above the normal hearing threshold (Southall et al. 2019). If the threshold shift does not return to normal, the residual shift is called a permanent threshold shift (PTS). Aside from natural causes, threshold shifts can result from acoustic trauma from a very intense sound of short duration, as well as from exposure to lower level sounds over longer time periods (Houser et al. 2017).

In marine mammals, the onset level and growth of TTS is frequency specific, depends on the temporal pattern, duty cycle, and the hearing test frequency of the fatiguing stimuli (Finneran 2015b, Finneran et al. 2017). Exposure to intense impulsive noise might be more hazardous to hearing than non-impulsive noise, and there is a positive relationship between exposure duration and the amount of TTS induced. The role of the temporal pattern of sound on TTS in marine mammals has been studied in both high-frequency and very high-frequency cetaceans (Mooney et al. 2009, Finneran et al. 2010, Kastelein et al. 2014, Kastelein et al. 2015b). The results of these studies show that TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same total sound exposure level (Finneran et al. 2010). Though the relationship between the onset levels of TTS and the onset levels of PTS is not fully understood for marine mammal species, PTS onset acoustic thresholds have been extrapolated from marine mammal TTS measurements using growth rates from terrestrial and marine mammal data (Finneran et al. 2017).

While PTS undoubtedly constitutes an injury, TTS is a temporary phenomenon, and (especially when mild) is not considered to represent physical damage or “injury” (Southall et al. 2007, Le Prell et al. 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. In its regulatory guidance, therefore, NOAA Fisheries does not consider TTS to be injurious (NMFS 2018). Some research, however, has shown that sound exposure can cause cochlear neural degeneration even when threshold shifts and hair cell damage are reversible (Kujawa and Liberman 2009, Liberman 2016). Whether TTS should continue to be considered a non-injurious effect is under debate (Weilgart 2014, Tougaard et al. 2015, 2016).

TTS has been demonstrated and studied in captive odontocetes and pinnipeds exposed to loud sounds (reviewed in Southall et al. 2007, Finneran 2015a) but currently there is no documented evidence of TTS (or PTS) in free-ranging marine mammals exposed to anthropogenic sounds under realistic field conditions. Marine mammal TTS data from impulsive sources are therefore limited. Finneran et al. (2002) reported a behaviorally-measured TTS of 6 and 7 dB in a captive beluga whale exposed to single impulses from a seismic water gun. And, Lucke et al. (2009) reported AEP-measured TTS of 7 to 20 dB in a captive harbor porpoise exposed to single impulses from a seismic air gun. In addition to these seismic data, Kastelein et al. (2015a) reported a behaviorally-measured mean TTS of 4 dB at 8 kHz and 2 dB at 4 kHz after a harbor porpoise was exposed to a series of impulsive sounds produced by broadcasting underwater recordings of impact pile driving strikes through underwater sound projectors. The cumulative SEL was approximately 180 dB re 1 µPa^2·s. The pressure waveforms for the simulated pile strikes exhibited significant “ringing” not present in the original recordings, and most of the energy in the broadcasts was between 500 and 800 Hz. As a result, some questions exist regarding whether the fatiguing signals were representative of underwater pressure signatures from impact pile driving.

Several impulsive noise exposure studies have failed to find behaviorally measurable TTS. Finneran et al. (2000) exposed dolphins and beluga whales to single impulses from an “explosion simulator” and Finneran et al. (2015) exposed three dolphins to sequences of ten impulses from a seismic air gun (maximum cumulative SEL: 193–195 dB re 1 µPa^2·s, PK: 196–210 dB re 1 µPa) without measurable TTS. Finneran et al. (2003) also exposed two sea lions to single impulses from an arc-gap transducer with no measurable TTS (maximum unweighted SEL: 163 dB re 1 µPa^2·s, PK: 183 dB re 1 µPa).

The criteria used in the exposure modeling (Section 6.2.2) (NMFS, 2018) reflect the most recent scientific review and conclusions of NMFS regarding sound levels that could cause PTS. Based on the exposure modeling results (Tables 24–26), the number of marine mammals that may experience hearing impairment is quite small, even when planned mitigation measures are not considered. Taking those criteria into account, the likelihood of Atlantic Shores construction activities causing PTS in a marine mammal is negligible.

7.2. Potential Effects of HRG Surveys on Marine Mammals

HRG surveys include multibeam, side-scan, single beam, and sub-bottom profile sonar and are considered an impulsive sound source. Many HRG sources operate at frequencies (>200 kHz) above the hearing range of marine mammals so are not expected to result in impacts. Sounds produced by HRG sources operating within the hearing range of marine mammals are unlikely to cause physical injury but could result in temporary behavioral responses (BOEM 2018).

7.2.1. Masking

There are limited data on the masking effects of pulsed sounds on marine mammal calls, and there are no direct studies on the impact of HRG surveys on masking in marine mammals. Data from seismic surveys, another impulsive sound source, shows that the detection rates of some cetacean calls are reduced in the presence of seismic pulses (Clark and Gagnon 2006, Nieukirk et al. 2012). However, it is often unclear if this is the result of masking or a cessation of calling activity. For the smaller odontocete species, the masking effects of low frequency, impulsive noise are expected to be insignificant because the calls of these species occur predominantly at much higher frequencies.

7.2.2. Behavioral Disturbance

HRG surveys include multibeam, side-scan, single beam, and sub-bottom profile sonar, and are considered an impulsive sound source. Limited data are available on the reaction of marine mammals to HRG surveys; however, some research is available on beaked whales. Varghese et al. (2020) found no consistent changes in Cuvier's beaked whale foraging behavior during multibeam echosounder surveys

Research on behavioral reactions to sonar, a similar sound source, have demonstrated temporary behavioral responses such as avoidance, change in behavioral state (i.e., cessation of feeding behavior), and changes in dive behavior (i.e., longer or shorter dive durations). For example, several behavioral reactions were seen in beaked whale species in response to mid- to high-frequency sonar sounds (12-400 kHz and 230 dB re 1 µPa) including cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other atypical dive behavior (Tyack et al. 2011, DeRuiter et al. 2013, Stimpert et al. 2014, Miller et al. 2015, Cholewiak et al. 2017). Minke whales demonstrated strong avoidance to mid-frequency sonar at 146 dB re 1 µPa (Sivle et al. 2015, Kvadsheim et al. 2017) and Wensveen et al. (2019) showed northern bottlenose whales had a greater response to (military) sonar signals. Surface-feeding blue whales showed no changes in behavior to mid-frequency sonar, but blue whales feeding at deeper depths and non-feeding whales displayed temporary reactions to the source; including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter et al. 2013, Goldbogen et al. 2013, Sivle et al. 2015). Several behavioral reactions were seen in beaked whale species in response to mid-frequency sonar sounds (12-400 kHz and 230 dB re 1 µPa) including cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other atypical dive behavior (Tyack et al. 2011, DeRuiter et al. 2013, Stimpert et al. 2014, Miller et al. 2015, Cholewiak et al. 2017). Sperm whales, killer whales, and long-finned pilot whales have also all demonstrated moderate behavioral responses to mid-frequency sonar, with avoidance of the sound source observed most frequently (Miller et al. 2012).

Exposure to mid-frequency sonar at various sound levels (125–185 dB re 1 µPa) caused behavioral responses in California sea lions (*Zalophus californianus*), including a refusal to participate in trials, hauling out, an increase in respiration rate, and an increase in the time spent submerged (Houser et al. 2016). Hooded seals showed initial avoidance behavior to 1–7 kHz sonar signals at levels between 160 and 170 dB re 1 µPa, but these animals did adapt to the sound and stopped avoiding the source (Kvadsheim et al. 2010).

7.2.3. Hearing Impairment

There are no direct studies on the impact of HRG surveys on hearing impairment in marine mammals. While impulsive sounds have been shown to cause TTS in both beluga whales (Finneran et al. 2002) and harbor porpoises (Lucke et al. 2009), other studies have failed to elicit TTS in response to impulsive sounds in bottlenose dolphins, belugas, or California sea lions (Finneran et al. 2000, Finneran et al. 2003, Finneran et al. 2015).

Potential Effects of Vibratory Piling for Cofferdam Installation and Removal on Marine Mammals

Sheet-pile cofferdams are typically driven into the seabed using vibratory hammers, resulting in a continuous noise source. While there are no direct studies on the effects of cofferdam installation and removal on marine mammals, there are data on the effects of vibratory pile driving which also uses vibratory hammers. Vibratory pile installation typically produces lower amplitude sounds in the marine environment than impact hammer installation (Rausche and Beim 2012). Exposure to vibratory hammer sounds is therefore unlikely to induce injury because of its lower peak pressure levels, however behavioral disturbance may occur.

7.2.4. Masking

Although bottlenose dolphins exposed to playbacks of noise from vibratory piling eventually increased their echolocation rates, there was no evidence that this was due to masking (Branstetter et al. 2018). The communicative whistles of some species, however, may be more susceptible to masking due to their lower peak frequencies. For example, the echolocation clicks of Indo-pacific humpback dolphins have a peak frequency of 43.5 to 142.1 kHz, while their whistles range from 520 Hz to 33 kHz (Wang et al. 2014). As the dominant frequency of the vibratory hammer measured during that study was below 10 kHz, the authors concluded that the echolocation clicks of this species would be largely unaffected, but the whistles in this species could be susceptible to masking.

7.2.5. Behavioral Disturbance

The noise resulting from vibratory piling activities has been demonstrated to impact the echolocation abilities of bottlenose dolphins. When dolphins were exposed to playbacks of vibratory piling, they significantly reduced the number of echolocation clicks on a target compared to periods with no exposure to noise. However, they increased the rate of echolocation after the initial trial, indicating that the dolphins were able to acclimate to the piling noise (Branstetter et al. 2018). Vibratory piling activity has also been associated with a decrease in the probability of occurrence in bottlenose dolphins and harbor porpoises and with a reduction in the time spent in the area of vibratory piling for bottlenose dolphins (Graham et al. 2017). These responses were observed at predicted received single-pulse SEL values of between 98.8 and 131.7 dB re 1 lPa2 s. Neither species was excluded from the area, and both continued to be present during vibratory piling activities.

7.2.6. Hearing Impairment

There are no direct studies on the impact of vibratory pile driving on hearing impairment in marine mammals. However, based on the source levels measured near a vibratory hammer, Wang et al. (2014) concluded that TTS or PTS could be exceeded under certain conditions (e.g. prolonged exposure) for Indo-pacific humpback dolphins. This study was conducted based on the world’s largest vibratory hammer, however, and are likely not applicable to all vibratory piling activities.

7.3. Summary

As detailed in Sections 7.1 through 7.2.6, due to the uncertainties in predicting the quantity and types of impacts of sound on marine mammals, JASCO took a highly conservative approach to calculating marine mammal harassment. This approach included rounding up to an integer for all predicted exposures (even those significantly lower than one), rounding up Level B exposures to an average group size when the model predicted fewer than one group size, using worst case scenarios from the three proposed construction schedules, and assuming 10 dB of broadband sound attenuation. Additionally, the mitigation measures detailed in Section 11 were not considered when predicting harassment, except for the NARW, for which special mitigation will be applied to reduce potential Level B harassment and to eliminate Level A harassment entirely. Many of these measures will also reduce harassment of other marine mammal species.

As seen in Tables 24– 26 in Section 6.2.5, low-frequency cetaceans are more likely to exceed the Level A SEL exposure threshold than other cetaceans. This occurs because the hearing frequency of this group overlaps with the highest energy frequency bands produced during pile driving. Nonetheless, even when using the conservative measures applied to calculate Level A takes for the full buildout of the Projects from the estimated exposures, the percentages of the low-frequency cetacean species' populations that could potentially be taken by Level A and Level B harassment combined are all less than 2% per year, assuming 10 dB of sound attenuation, as shown in Table 41, for all species except the NARW because of its small population size, and the coastal stock of bottlenose dolphins. For NARW, the maximum yearly Level B take request is approximately 4%. The maximum yearly Level B harassment estimate as a percentage of population for the coastal stock of bottlenose dolphins is approximately 16% due to their high densities near the cofferdam locations and because the Level B threshold for vibratory drilling during cofferdam installation, a continuous sound, is only 120 dB. This estimate does not include the mitigation measures proposed in Section 11.4, which are likely to reduce Level B harassment. Level A harassment will be avoided through the use of special mitigation to protect this species (Section 11). Although HF cetaceans have reduced sensitivity at lower frequencies, their lower sensitivity at these frequencies is counteracted by the much lower threshold for PTS injury for this hearing group (155 dB re 1 µPa2s). Nonetheless, the percentage of the harbor porpoise population that could potentially be taken by Level B plus Level A harassment is less than 0.5% per year. For mid-frequency cetaceans as well as for pinnipeds, the Level A plus Level B take estimates as a percentage of population are all less than 1% of the population, except for bottlenose dolphins. No Level A take is anticipated for this species. The maximum percentage per year of the bottlenose dolphin offshore stock that could experience Level B harassment is ~7%. For the coastal stock, it is ~13%. Additionally, the mitigation measures proposed by Atlantic Shores, including noise attenuation of 10 dB, are anticipated to reduce Level A takes to near zero for all species, and to zero for the NARW for which additional mitigation measures are proposed (see Section 11).

Although the take calculation methods herein used a number of conservative assumptions, annual totals of Level B plus Level A harassment from all sound sources combined are predicted to affect <1% of the population for all marine mammal species except NARW (maximum of approximately 4%) and coastal bottlenose dolphins (maximum of approximately 16%; see Table 41). These percentages do not include the protective effect of any mitigation measures. Based on this approach to assessing potential exposures in the context of marine mammal population or stock sizes, impacts associated with the Projects on the species present in the region are expected to be negligible.

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 proposed action will take place in the Atlantic Shores Offshore Project Area in the North Atlantic Ocean. There are no relevant subsistence uses of marine mammals in the Offshore Project Area. As such, no relevant subsistence uses of marine mammals would be implicated by this action and no impacts to the availability of species or stocks for subsistence use are expected.

9. Anticipated Impacts on Habitat

Impacts to habitat from Atlantic Shores Offshore Wind have been thoroughly analyzed in its site characterization and impact assessment. These are summarized in Volume II of the COP. Under the maximum offshore buildout of the Projects, the total area of seafloor disturbance associated with piled foundation installation for the WTGs, OSSs, and met tower would be less than 3 km^2 in the WTA. The WTA alone is approximately 413.3 km^2, and thus, the maximum area of disturbance is only a very small proportion (<1%) of this larger area. The Lease Area is located within the NARW migration BIA that extends from Massachusetts to Florida and out to the shelf edge. NARW do not congregate near the Lease Area but are seasonally present as they migrate northward to feeding grounds during March and April and then southward to calving grounds in November and December.

9.1. Short-Term Habitat Alterations

Short-term benthic habitat alteration will occur through the installation of foundations, as well as the use of any jack-up or anchored vessels. This disturbance is expected to be limited to small areas of the seafloor and the habitat is anticipated to fully recover within a relatively short time period. For example, benthic habitat monitoring following construction of the Block Island Wind Farm off Rhode Island showed that all seafloor disturbance showed at least partial recovery and most had completely recovered within 2–3 years after construction as a result of sediment mobility (HDR 2020). Prey species of marine mammals directly in the path of these construction activities would be temporarily displaced, but mobile prey species are likely to be able to escape harm and avoid these areas during construction.

Pile driving, HRG survey activities, and cofferdam installation and removal will result in short-term, temporary alterations to the existing soundscape which may result in temporary, short-term impacts to marine mammals and their prey species. Soundscape alteration would be limited to the time when these activities occur. Such alterations are likely to lead to marine mammals avoiding habitat areas undergoing activity. Changes to the soundscape from pile driving activities may elicit physical or behavioral responses (e.g., aversion and avoidance) in marine mammal prey species such as fish (see Popper and Hawkins 2019 for a review) and invertebrates (e.g. Jones et al. 2020, Jones et al. 2021). With respect to fish species, physical injury from impulsive noise production could occur, but such impacts would be limited to species which contain a swim bladder connected to the inner ear (e.g., Atlantic herring [*Clupea harengus*] and cod [*Gadus morhua*]). Other fish species and marine invertebrates are likely to exhibit short-term behavioral changes (e.g., avoidance, alterations in feeding). HRG surveys are expected to be short-term and temporary with only minor, behavioral impacts on marine mammals and their prey species. Displaced prey are expected to return shorty after activity has concluded. These temporary, short-term impacts will be further minimized and mitigated through measures such as use of ramp-up procedures and implementation of noise abatement systems. These mitigation measures are described in further detail in Section 11 and are intended to eliminate the potential for marine mammal auditory injury as well as any injury to their prey.

In addition to noise, pile driving activities will result in temporary, short-term and localized increases in suspended sediment in the surrounding environment. Increases in suspended sediments are expected to have the greatest impact on sessile marine mammal prey organisms (e.g., eggs, larvae, and some benthic invertebrates). Studies have shown impacts to benthic invertebrates, eggs and larvae from suspended sediment and deposition could include abrasion, respiration interference, feeding disruption, reduced growth rate, and in some cases, mortality (Johnson 2018; Wilber and Clarke 2001; Kjelland et al. 2015); however, these impacts are typically observed at high suspended sediment concentrations that span multiple days. Recent studies have shown that both suspended sediment concentration and exposure durations largely influence the extent of impacts to marine organisms (Wilber and Clark 2001). Suspended sediments are expected to settle quickly out of the water column (i.e., hours rather than days); therefore, significant impacts to sessile organisms such as eggs, larvae, and benthic invertebrates are not expected.

9.2. Longer-Term Habitat Alterations

Longer-term habitat alterations resulting from the Projects include the creation of hard substrate around WTG and OSS foundations and the loss of habitat from the footprint of the installations as well as the introduction of structures into the water column. The total permanent alteration from piled WTG, OSS, and met tower foundations is only 1.1 km^2, which is minor compared to the available surrounding habitat. These structures are intended to remain in place throughout the approximately 30-year operational life of the Projects. The introduction of structures into the water column is not anticipated to create a barrier to movement for marine mammals given the proposed WTA layout configuration. The effects of habitat alteration on marine mammals are discussed further in Section 10.2.

10. Anticipated Effects of Habitat Impacts on Marine Mammals

10.1. Short-Term Habitat Alterations

The temporarily altered soundscape resulting from pile driving is likely to have the greatest impact on the marine mammal community. Habitat displacement or avoidance of construction activities by marine mammals is expected during foundation installation and HRG surveys based on modeled sound levels and studies of other wind energy projects showing significant avoidance behavior and displacement during pile driving (Richardson et al. 1995, Carstensen et al. 2006, Tougaard et al. 2009, Brasseur et al. 2010, Brandt et al. 2011, Dähne et al. 2013, Bailey et al. 2014, Bergström et al. 2014). Research suggests that this displacement is limited temporally to the construction phase, and re-occupation of habitat in the Project Area is expected to occur at levels equivalent to or higher than the region around the project post-construction and during operation (Bergström et al. 2014). The Project Area is located within a Migration BIA for North Atlantic right whales from March-April for their Northward migration and November-December for their Southward migration (Biologically Important Area Map (noaa.gov)). However, no construction is planned between January and April to avoid overlap with this species. Construction activity may overlap with their Southward migration (November-December), however (Whitt et al. 2013). Therefore, no long-term impacts to marine mammal habitat utilization are anticipated from survey or construction activities.

Any short-term impacts to marine mammal prey are likely to have negligible impacts to marine mammals because the Lease Area is not located in any known feeding ground, and any feeding in the area would be opportunistic.

10.2. Longer-Term Habitat Alterations

As discussed in Section 9, alteration of existing benthic habitat will occur as a result of the creation of hard substrate around the foundations and from the footprint of the installations. Additionally, water column habitat will be altered by the introduction of structures. While various studies of the impact of wind farms in Europe have produced inconsistent results, marine mammals are likely to use the area after the WTGs are installed, as demonstrated by the continued use of areas where other structures have been built in marine environments.

The large spacing between WTGs will minimize the extent of habitat modification that could potentially impact marine mammals. Barriers to activities, including migration, are not anticipated from modification of the water column habitat. Thus, these longer-term habitat alterations are unlikely to have a negative impact on marine mammals.

There are data to suggest that marine mammals could be attracted to the Projects' infrastructure. Studies of harbor porpoise echolocation clicks around oil and gas installations in the North Sea suggest they were feeding around these structures (Todd et al. 2009, Clausen et al. 2021). Todd et al. (2020) compiled and analyzed video from offshore operators that showed sperm whales, bottlenose dolphins, and gray and harbor seals in the vicinity of offshore structures. Russell et al. (2014) conducted a tagging study of harbor and grey seals living near two active wind energy project areas on the British and Dutch coasts of the North Sea. The tag data strongly suggested that the associated wind energy structures were used for foraging, and the directed movements showed that animals could effectively navigate to and between structures (Russell et al. 2014). The presence of foundations may attract prey species of marine mammals as these structures provide shelter and feeding opportunities as well as spawning and nursery grounds for prey species in an area that is largely comprised of flat, sandy habitat (ICF 2020). This phenomenon, known as the reef effect, has been documented around oil and gas platforms off the coast of California, in the Gulf of Mexico (e.g., Claisse et al. 2014, Ajemian et al. 2015, Love et al. 2015), and in North Sea (Fujii 2016), as well as around the Horns Rev Wind Farm in the North Sea (Leonhard et al. 2011) and the Block Island Wind Farm off the coast of Rhode Island (HDR 2020b). In addition to greater food availability near offshore structures, where certain vessels and/or vessel-based activities are excluded from portions of the area for periods of time, the Projects' infrastructure may provide shelter for marine mammals (e.g., Scheidat et al. 2011).

11. Mitigation Measures to Protect Marine Mammals and Their Habitat

Atlantic Shores is committed to minimizing Project-related impacts to marine mammal species through a comprehensive monitoring and mitigation program. The monitoring and mitigation measures presented herein represent Atlantic Shores' baseline commitment to ensure the protection of marine mammals during Project activities and represent industry best management practices. The measures described in the following sections are intended to reduce or eliminate exposure of marine mammals to underwater sound levels that could constitute a "take" under the MMPA. The measures to be implemented during HRG surveys and/or construction include, but are not limited to:

1. Noise attenuation through use of a noise mitigation system;
2. Seasonal restrictions and speed restrictions;
3. Standard PSO training and equipment requirements;
4. Visual monitoring; including low visibility monitoring tools;
5. Passive acoustic monitoring;
6. Establishment and monitoring of shutdown zones (SZs);
7. Pre-start clearance;
8. Ramp-up (soft-start) procedures;
9. Operations monitoring;
10. Operational shutdowns and delay;
11. Sound source measurements of at least one foundation installation;
12. Survey sighting coordination;
13. Vessel strike avoidance procedures; and
14. Data recording and reporting procedures.

The specifics for all monitoring and mitigation measures to be conducted during the Projects will be described in the Project-specific Protected Species Management and Equipment Specifications Plan (PSMESP, see Appendix E). The selection and implementation of appropriate mitigation measures will consider safety, practical application, effectiveness, and advancements in the industry such as implementing lessons learned from other developers. While protection of marine mammals is a top priority, environmental and human health and safety is the very highest priority when working in the offshore environment; therefore, revisions or exceptions and allowances for adaptive plans to monitoring and mitigation measures described in the PSMESP may be made under certain circumstances.

The PSMESP includes activity specific monitoring plans including:

- Vessel Strike Avoidance Plan;
- Monitoring and mitigation plan for high resolution geophysical (HRG) surveys;
- Construction Plan for Impact Piling WTG and OSS foundation installations;
- Construction Plan for Vibratory Pile Driving of Sheet Pile;
- Operations Mitigation and Monitoring Protocols;
- Passive Acoustic Monitoring Plan;
- Sound Field Verification Plan;
- Reporting Plan; and

- North Atlantic Right Whale Vessel Strike Avoidance Plan.

Each plan will be developed in consultation with NMFS and will be provided to NMFS for review and approval at least 90 days prior to the commencement of construction activities.

Atlantic Shores is also evaluating additional innovative technologies and methods to improve the monitoring of marine mammals within the Offshore Project Area and to further inform regional efforts to understand cumulative impacts to these species. Through partnerships with universities, governmental agencies and environmental non-governmental organizations, Atlantic Shores is working with marine mammal experts to identify key knowledge gaps and to plan studies to advance the general understanding of marine mammals in the Mid-Atlantic Bight. Other innovations Atlantic Shores is currently investigating to further minimize impacts to marine mammal include:

- Near Real-Time Monitoring – Various acoustic technologies (e.g., passive underwater acoustic monitors, cable hydrophones) provide advantages for real-time monitoring of marine mammal vocalizations indicating species presence in an area.
- Autonomous Underwater Vehicles – Autonomous Underwater Vehicle technologies allow for remotely controlled data collection of the underwater environment without divers or intrusive methods to detect marine life and changing environmental conditions during certain Project activities (e.g., construction).
- Unmanned Aerial Systems – Unmanned aerial systems are not proposed to be used as replacement for boat based monitoring at this time. Atlantic Shores will continue engagement with NMFS about opportunities to conduct trial studies. If proposed for Project use, a Drone Monitoring and Mitigation Plan will be provided to NMFS for review and approval. The plan will specifically address PSO staffing levels.

11.1. Standard Mitigation and Monitoring Requirements for All Activities

11.1.1. Protected Species Observer (PSO) and Passive Acoustic Monitoring (PAM) Operator training, experience, and responsibilities

- All PSOs and PAM Operators will have completed a PSO training course;
- The PSO field team and the PAM team will have a lead observer (Lead PSO and PAM Lead) who will have experience in the northwestern Atlantic Ocean on similar projects Roles and responsibilities of the Lead and support PSOs are outlined in detail in the PSMESP which is provided in Appendix E;
- Remaining PSOs and PAM operators will have previous experience on similar projects and the ability to work with the relevant software and equipment;
- PSO and PAM Operators resumes will be provided to NOAA Fisheries for review and approval prior to the start of activities;
- PSOs and PAM operators will complete a Permits and Environmental Compliance Plan (PECP) training and a two-day training and refresher session with the PSO provider and Project compliance representatives before the anticipated start of Project activities;
- PSOs will be employed by a third-party observer provider and will have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew

with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards); and

- Situational Awareness/Common Operating Picture and Coordination: Atlantic Shores will establish a situational awareness network for marine mammal and sea turtle detections through the integration of sighting communication tools such as Mysticetus, Whale Alert, WhaleMap, etc. This network will be monitored daily, and any sighting information will be made available to all project vessels. In addition, field personnel will:
    - Monitor the NMFS North Atlantic right whale reporting systems daily;
    - Monitor U.S. Coast Guard VHF Channel 16 throughout the day to receive notifications of any sighting; and
    - Monitor any existing real-time acoustic networks.

11.1.2. Visual Monitoring

- No individual PSO will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during a 24-hour period;
- Each PSO will be provided with one 8-hour break per 24-hour period to sleep;
- Sample watch schedules are provided in Appendix E – Protected Species Management and Equipment Specifications Plan;
- Observations will be conducted from the best available vantage point(s) on the vessels (stable, elevated platform from which PSOs have an unobstructed 360° view of the water);
- PSOs will systematically scan with the naked eye and a 7 x 50 reticle binocular, supplemented with night-vision equipment when needed. When monitoring at night or in low visibility conditions, PSOs will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons, a hand-held spotlight, and/or a mounted thermal camera system;
- Activities with larger monitoring zones will use 25 x 150 mm “big eye” binoculars; and
- Vessel personnel will be instructed to report any sightings to the PSO team as soon as they are able and it is safe to do so.

11.1.3. Acoustic Monitoring (WTG and OSS Foundation Installation Only)

- Deployment of PAM system will be outside the perimeter of the shutdown zone (SZ); and
- PSOs will be given adequate breaks and will work no longer than 12 hours per day.

11.1.4. Vessel Strike Avoidance

Atlantic Shores will implement vessel strike avoidance measures including but not limited to the following except under circumstances when complying with these requirements would put the safety of the vessel or crew at risk or when the vessel is restricted in its ability to maneuver. In addition to the Base Conditions for Vessel Strike Avoidance below, Atlantic Shores will implement a Standard Plan or an Adaptive Plan as presented below. These three plans are intended to be interchangeable and implemented throughout both the construction and operations phases of the project. At described above in Section 11, Atlantic Shores will submit a final NARW Vessel Strike Avoidance Plan. This plan will be provided to NMFS at least 90 days prior to commencement of vessel use and further details the Adaptive Plan and specific monitoring equipment to be used. The plan will, at a minimum, describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of NARWs. The plan will also provide details on the vessel-based observer protocols on transiting vessels.

11.1.4.1. General Operational Measures

- All personnel working offshore will receive training on marine mammal awareness and vessel strike avoidance measures;
- A vessel crew training program will be provided to NOAA Fisheries for review and approval prior to the start of activities. All vessel crew members will be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout activities offshore;
- Vessel personnel will maintain a vigilant watch for marine mammals and slow down or maneuver vessels as appropriate to avoid striking marine mammals; and
- When marine mammals are sighted while a vessel is underway, the vessel will take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal’s course, avoid excessive speed or abrupt changes in direction until the animal has left the area).

11.1.4.2. Operational Separation Distances

- Vessels will maintain, to the extent practicable, separation distances of:
    - Greater than 500 m distance from any sighted NARW or unidentified large marine mammals;
    - Greater than 100 m from all other whales; and
    - Greater than 50 m for dolphins, porpoises, and seals.

11.1.4.3. Standard Vessel Avoidance Plan

- Implement Base Conditions as described above;
- **Between November 1st and April 30th:** Vessels greater than or equal to 65 ft (19.8 m) in overall length, excluding CTVs, will operate at 10 knots or less between November 1 and April 30 while transiting to and from the Project Area except while transiting areas which have not been demonstrated by best available science to provide consistent habitat for NARW. Vessels greater than or equal to 65 ft (19.8 m) in overall length, including CTVs, will operate at 10 knots or less when within any active Seasonal Management Area (SMA);
- **Year Round**: Vessels of all sizes will operate at 10 knots or less in any Dynamic Management Areas (DMAs);
- **Between May 1st and September 30th**: All underway vessels (transiting or surveying) operating at >10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90°starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog, etc.);
- The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements; and
- Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members.

11.1.4.4. Adaptive Vessel Avoidance Plan

Atlantic Shores will adhere to the Standard Plan outlined above except in cases where crew safety is at risk, and/or labor restrictions, vessel availability, costs to the project, or other unforeseen circumstance make these measures impracticable. To address these situations, an Adaptive Plan will be developed in consultation with NMFS to allow modification of speed restrictions for vessels. Should Atlantic Shores choose not to implement this Adaptive Plan or a component of the Adaptive Plan is offline (e.g., equipment technical issues), Atlantic Shores will default to the Standard Plan (described above). The Adaptive Plan will not apply to vessels greater than or equal to 65 ft (19.8) in length subject to speed reductions in SMAs as designated by NOAA’s Vessel Strike Reduction Rule.

- **Year Round:** A semi-permanent acoustic network comprising near real-time bottom mounted and/or mobile acoustic monitoring platforms will be installed year-round such that confirmed NARW detections are regularly transmitted to a central information portal and disseminated through the situational awareness network;
    - The transit corridor and Offshore Project Areas will be divided into detection action zones;
    - Localized detections of NARW in an action zone would trigger a slow-down to 10 knots or less in the respective zone for the following 12 hours. Each subsequent detection would trigger a 12-hour reset. A zone slow-down expires when there has been no further visual or acoustic detection in the past 12 hours within the triggered zone; and
    - The detection action zone’s size will be defined based on efficacy of PAM equipment deployed and subject to NMFS approval as part of the NARW Vessel Strike Avoidance Plan.
- **Year Round:** All underway vessels (transiting or surveying) operating > 10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor

for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90°starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog, etc.). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members;

- **Year Round**: If any DMA is established that overlaps with an area where a project vessel would operate, that vessel, regardless of size when entering the DMA, may transit that area at a speed of 10 knots or less. Any active action zones within the DMA may trigger a slow down as described above; and
- If PAM and/or thermal systems are offline, the Standard Vessel Avoidance Plan measures will apply for the respective zone (where PAM is offline) or vessel (if automated visual systems are offline).

11.1.5. Data Recording

- All data will be recorded using industry-standard software, and or standardized data forms, whether hard copy or electronic; and
- Data recorded will include information related to ongoing operations, observation methods and effort, visibility conditions, marine mammal detections (e.g., species, age classification [if known], numbers, behavior), and any mitigation actions requested and enacted.

11.1.6. Reporting

The following situations would require immediate reporting to appropriate POCs:

- If a stranded, entangled, injured, or dead marine mammal of protected species is observed, the sighting will be reported within 24 hours to the NMFS SAS hotline;
- If a protected species is injured or killed as a result of Project activities, the vessel captain or PSO on board will report immediately to NMFS Office of Protected Resources and Greater Atlantic Regional Fisheries Office no later than within 24 hours; and
- Any NARW sightings will be reported as soon as feasible and no later than within 24 hours to the NMFS SAS hotline or via the WhaleAlert Application.

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

- All vessels will utilize a standardized data entry format;
- A database of all sightings and associated details (e.g., distance from vessel, behavior, species, group size/composition) within and outside of the designated SZs, monitoring effort, environmental conditions, and Project-related activity will be provided after field operations and reporting are complete. This database will undergo thorough quality checks and include all variables required by the NMFS-issued Incidental Take Authorization (ITA) and BOEM Lease OCS-A 0499 and will be required for the Final Technical Report due to BOEM and NMFS;
- During construction, weekly reports briefly summarizing sightings, detections and activities will be provided to NMFS and BOEM on the immediate Wednesday following a Sunday-Saturday period;

- Final reports will follow a standardized format for PSO reporting from activities requiring marine mammal mitigation and monitoring; and
- An annual report summarizing the prior year's activities will be provided to NMFS and to BOEM on April 1 every calendar year summarizing the prior year's activities.

11.2. WTG and OSS Foundation Installation

11.2.1. Monitoring Equipment

Monitoring equipment planned for use during standard daytime, low-visibility and nighttime piling is presented in Table 47.

Table 47. Monitoring equipment planned for use during standard daytime and low-visibility and nighttime piling.

Item	Standard daytime		Monitoring for nighttime and low visibility	
	Construction vessels	Secondary vessels	Construction vessels	Secondary vessels
Reticle binoculars	2	2	0	0
Mounted thermal/IR camera system[a]	1	1	1	1
Mounted "big-eye" binocular	1	1	0	0
Monitoring station for real time PAM system[b]	1	1	1	1
Hand-held or wearable NVDs	0	0	2	2
IR spotlights	0	0	2	2
Data collection software system	1	1	1	1
PSO-dedicated VHF radios	2	2	2	2
Digital single-lens reflex camera equipped with 300-mm lens	1	1	0	0

[a] The camera systems will be automated with detection alerts that will be checked by a PSO on duty; however, cameras will not be manned by a dedicated observer.

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

11.2.2. Visual Monitoring

- There will be six to eight visual PSOs and PAM operators on the impact pile driving vessel and six to eight visual PSOs and PAM operators on any secondary marine mammal monitoring vessel; and
- Two visual PSOs will be watch on each construction and secondary vessel during pre-start clearance, throughout impact pile driving and 30 minutes after piling is completed.

11.2.3. Daytime Visual Monitoring

- PSOs will monitor for 30 minutes before and after each piling event;
- Two PSOs will monitor the SZ with the naked eye and reticle binoculars while one PSO periodically scans outside the SZ using the mounted big eye binoculars; and
- The secondary vessel, if used, will be positioned and circling at the outer limit of the Large Whale SZ.

11.2.4. Daytime Periods of Reduced Visibility

- If the monitoring zone is obscured, the two PSOs on watch will continue to monitor the SZ using thermal camera systems and handheld night-vision devices (NVDs) (as able); and
- All PSOs on duty will be in contact with the on-duty PAM operator who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.

11.2.5. Nighttime Visual: Construction and Secondary Vessel

- Visual PSOs will rotate in pairs: one observing with an NVD and one monitoring the / infrared (IR) thermal imaging camera system[8]; and
- Deck lights will be extinguished or dimmed during night observations when using NVDs; however, 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. If a PSO is still unable to monitor the required visual zones piling would not occur.

11.2.6. Acoustic Monitoring

- PAM operator will monitor during all pre-start clearance periods, piling, and post-piling monitoring periods (daylight, reduced visibility, and nighttime monitoring);
- One PAM operator on duty during both daytime and nighttime/low visibility monitoring;
- Real-time PAM systems require at least one PAM operator 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; and
- PAM operator will inform the PSOs on duty of animal detections approaching or within applicable ranges of interest to the pile-driving activity.

11.2.7. Shutdown Zones

Mitigation and monitoring zones for Level A harassment are based on modelled, species-specific, exposure ranges. The maximum exposure range was chosen for any piling scenario.

The Level B monitoring zones, which will be applied to all marine mammal species, are based on the largest acoustic ranges for any piling scenario using the NOAA (2005) data source and modelled by JASCO.

The Level A exposure ranges, Level B monitoring zone, mitigation zones, and vessel separation distances for impact pile driving are summarized below in Table 1 below. The mitigation zones are subject to modification based on final engineering design.

These zones and ranges are based on modelled piling scenarios for monopile and jacket pile installation and assume 10 dB broadband noise attenuation. Mitigation zones established for all species, including the North Atlantic right whale (NARW), will be applied accordingly as depicted in the Table. Monitoring zones

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[8] PAM operators may be located on shore.

for Level B behavioral harassment during the Project may be modified, with NMFS approval, based on measurements of the received sound levels during piling operations.

Mitigation and monitoring zones for Level A harassment assume either one or two monopiles driven per day, and either four pre-piled or post-piled pin piles driven per day. When modelled injury threshold distances differed among these scenarios, the largest for each species group was selected for conservatism. The pre- piling clearance zones, referred to as buffer zones, for large whales, porpoise, and seals are based upon the maximum Level A exposure zone for each group. The NARW pre-piling clearance zone was established to be equal to the Level B zone to avoid any preventable exposures. The shutdown zones for large whales, NARW, porpoise, and seals are based upon the maximum Level A zone for each group.

Table 48. Summary of pre-piling search periods and monitoring and mitigation zones during foundation installation with a Noise Abatement System (NAS) and 10 dB of attenuation

	Duration of clearance search	Buffer zone (m)*	Exclusion zone (m)*	Level B monitoring zone (m)*	Post-piling monitoring
NARW	30 mins	1,900	1,900	3,900	30 mins
Large whales	30 mins	1,900	1,900	3,900	30 mins
Delphinids	30 mins	1,900	NSD**	3,900	30 mins
Harbor porpoise	30 mins	1,900	1,480	3,900	30 mins
Seals	30 mins	1,900	320	3,900	30 mins
Sea turtles	30 mins	1,900	100	N/A	30 mins

* NOAA (2005); the buffer zone refers to the potential pre-piling clearance zones

** No shutdown required as the modelled level A take distances for all species in the delphinid group are either 0 meters or negligible distances

The mitigation zones are subject to modification based on final engineering design.

11.2.8. Pre-Start Clearance

- Piling may be initiated any time within a 24-hour period;
- Prior to the beginning of each pile driving event, PSOs and PAM operators will monitor for marine mammals for a minimum of 30 minutes and continue at all times during pile driving;
- All clearance zones will be confirmed to be free of marine mammals prior to initiating ramp-up and the large whale clearance zones will be fully visible, and the NARW acoustic zone monitored for at least 30 minutes prior to commencing ramp-up; and
- If a marine mammal is observed entering or within the relevant clearance zones prior to the initiation of pile driving activity, pile driving activity will be delayed and will not begin until either the marine mammal(s) has voluntarily left the respective clearance zones 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 small odontocetes and 30 minutes for all other species).

11.2.9. Ramp up (Soft Start)

- Each monopile installation will begin with a minimum of 20-minute soft-start procedure as technically feasible;

- Soft-start procedure will not begin until the clearance zones has been cleared by the visual PSO or PAM operators; and
- If a marine mammal is detected within or about to enter the applicable clearance zones, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been observed exiting the clearance zones or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).

11.2.10. Shutdowns

- If a marine mammal is detected entering or within the respective SZs after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless Atlantic Shores determines shutdown is not feasible due to an imminent risk of injury or loss of life to an individual;
- If shutdown is called for but it is determined that shutdown is not feasible due to risk of injury or loss of life, there will be a reduction of hammer energy;
- Following shutdown, pile driving will only be initiated once all SZs are confirmed by PSOs to be clear of marine mammals for the minimum species-specific time periods;
- The SZ will be continually monitored by PSOs and PAM during any pauses in pile driving; and
- If a marine mammal is sighted within the SZ during a pause in piling, piling will be delayed until the animal(s) has moved outside the SZ and no marine mammals are sighted for a period of 30 minutes.

11.2.11. Post-Piling Monitoring

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

11.2.12. Noise Attenuation

- Atlantic Shores will use an NMS for all impact piling events and is committed to achieving 10 dB of noise attenuation. The type and number of NAS to be used during construction have not yet been determined but will consist of a single bubble curtain paired with an additional sound attenuation device or a double big bubble curtain. Based on prior measurements this combination of NAS is reasonably expected to achieve greater than 10 dB broadband attenuation of impact pile driving sounds.

11.2.13. Sound Measurements

- Measurements of the installation of at least foundation installation will be made and results used to modify SZs, as appropriate; and
- For each foundation installation measured, Atlantic Shores will estimate ranges to Level A and Level B harassment isopleths by extrapolating from in-situ measurements at multiple distances from the foundation including at least one measurement location at the most conservative distance for the Exclusion Zone and the Monitoring zone (see table 48).

11.3. HRG Surveys

The following monitoring and mitigation measures for HRG surveys apply only to sound sources with operating frequencies below 180 kHz. There are no monitoring or mitigation protocols required for sources operating below 180 kHz.

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

11.3.1. Monitoring Equipment

- Two pairs of reticle binoculars;
- One mounted thermal/ IR camera system during nighttime and low visibility conditions;
- Two hand-held or wearable NVDs;
- Two IR spotlights;
- One data collection software system;
- Two PSO-dedicated VHF radios; and
- One digital single-lens reflex camera equipped with a 300-mm lens.

11.3.2. Visual Monitoring

- Four to six PSOs on all 24-hour survey vessels;
- Two to three PSOs on all 12-hour survey vessels; and
- The PSOs will begin observation of the SZs prior to initiation of HRG survey operations and will continue throughout the survey activity and/or while equipment operating below 180 kHz is in use.

11.3.3. Daytime Visual Monitoring (period between nautical twilight rise and set for the region)

- One PSO on watch during all pre-clearance periods and all source operations; and
- PSOs will use reticle binoculars and the naked eye to scan the monitoring zone for marine mammals.

11.3.4. Nighttime and Low Visibility Visual Observations

- The lead PSO will determine if conditions warrant implementing reduced visibility protocols;
- Two PSOs on watch during all pre-clearance periods and operations; and
- Each PSO will use the most appropriate available technology (e.g., IR camera and NVD) and viewing locations to monitor the SZs and maintain vessel separation distances.

11.3.5. Shutdown Zones

- North Atlantic right whale: 500 m
- All other marine mammal species: 100 m
- Certain Delphinus, Lagenorhynchus, Stenella, or Tursiops that are visually detected as voluntarily approaching the vessel or towed equipment: No SZ

11.3.6. Pre-Start Clearance

- Prior to the initiation of equipment ramp-up, PSOs and PAM operators will conduct a 30-minute watch of the clearance zones to monitor for marine mammals;
- The clearance zones must be visible using the naked eye or appropriate visual technology during the entire clearance period for operations to start; if the clearance zones are not visible, source operations <180 kHz will not commence; and
- If a marine mammal is observed within its respective clearance zone during pre-clearance period, ramp-up will not begin until the animal(s) has been observed exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).

11.3.7. Ramp up (Soft Start)

- Ramp-up will not be initiated during periods of inclement conditions or if the clearance zones cannot be adequately monitored by the PSOs, using the appropriate visual technology for a 30-minute period;
- Ramp-up will begin by powering up the smallest acoustic HRG equipment at its lowest practical power output appropriate for the survey followed by a gradual increase and addition of other acoustic sources (as able);
- If a marine mammal is detected within or about to enter its respective clearance zone, ramp-up will be delayed; and
- Ramp-up will continue once the animal has been observed exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).

11.3.8. Shutdowns

- Shutdown of impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz is required if a marine mammal is sighted at or within its respective SZ;
- Shutdowns will not be implemented for dolphins that voluntarily approach the survey vessel;
- Subsequent restart of the survey equipment will be initiated using the same procedure described above during pre-start clearance;

- If the acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, it will be reactivated without ramp-up if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective SZs; and
- If the acoustic source is shut down 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.

11.4. Cofferdam Installation and Removal

11.4.1. Monitoring Equipment

- Two sets of 7 x 50 reticle binoculars;
- Two hand-held or wearable NVDs;
- Two IR spotlights;
- One data collection software system;
- Two PSO-dedicated VHF radios; and
- One digital single-lens reflex camera equipped with 300-mm lens

11.4.2. Visual Monitoring

- All observations will take place from one of the construction vessels stationed at or near the vibratory piling location;
- Two PSOs on duty on the construction vessel; and
- PSOs will continue to survey the SZ using visual protocols throughout the installation of each cofferdam sheet pile and for a minimum of 30 minutes after piling has been completed.

11.4.3. Daytime Visual Monitoring

- Two PSOs will maintain watch during the pre-start clearance period, throughout vibratory pile driving, and 30 minutes after piling is completed;
- Two PSOs will conduct observations concurrently; and
- One observer will monitor the SZ with the naked eye and reticle binoculars; one PSO will monitor in the same way but will periodically scan outside the SZ.

11.4.4. Daytime Visual Monitoring During Periods of Low Visibility

- One PSO will monitor the SZ with the mounted IR camera while the other maintains visual watch with the naked eye/binoculars.

11.4.5. Acoustic Monitoring

- No PAM operations will be conducted

11.4.6. Shutdown Zones

- The following shutdown zones will be enacted during vibratory piling if safe and technically feasible to do so:
    - Large whales (baleen whales including North Atlantic right whale + sperm whales): 100 m;
    - Mid-frequency cetaceans, excluding sperm whales: 50 m;
    - Harbor porpoise (high-frequency cetacean): 150 m; and
    - Seals: 60 m

11.4.7. Pre-Start Clearance

- PSOs will monitor the clearance zone for 30 minutes prior to the start of vibratory pile driving; and
- If a marine mammal is observed entering or within the respective clearance zones piling cannot commence until the animal has exited the clearance zone or time has elapsed since the last sighting (30 minutes for large whales, 15 minutes for dolphins, porpoises, and pinnipeds).

11.4.8. Ramp up (Soft Start)

- Ramp-up (a slow increase in power repeated three times) will be initiated if the clearance zone cannot be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period.

11.4.9. Shutdowns

- If a marine mammal is observed entering or within the respective SZs after sheet pile installation has commenced, a shutdown will be implemented; and
- The SZ must be continually monitored by PSOs during any pauses in vibratory pile driving, activities will be delayed until the animal(s) has moved outside the SZ and no marine mammals are sighted for a period of 15 minutes (small cetaceans and pinnipeds) or 30 minutes (large cetaceans and deep divers).

12. Mitigation Measure to Protect Subsistence Use

Not applicable. The Offshore Project Area lies off the U.S. northeast coast in the Atlantic Ocean, and no activities will take place in or near a traditional Arctic subsistence hunting area. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action.

13. Monitoring and Reporting

As required, Atlantic Shores will comply with the marine mammal reporting requirements for Project-related construction activities and HRG surveys as detailed below and in Section 11.

Reporting Injured or Dead Species: Atlantic Shores will report any sightings of any injured or dead marine to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866-755-NOAA [6622]) within 24 hours of a sighting, regardless of whether the injury or death is caused by a vessel. If the injury or death was caused by a collision with a Project-related vessel, Atlantic Shores will ensure that NMFS is notified of the strike within 24 hours. 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 the Projects' activity is responsible for the injury or death, Atlantic Shores will make every reasonable effort to supply a vessel to assist in any recovery of the animal as requested by NMFS.

Detailed dead/injured reporting procedures and reporting procedures for observed impacts to protected species are included in the PSMESP in Appendix E,

Reporting Observed Impacts on Species: The observers will report any observations concerning impacts on marine mammals to NMFS within 48 hours after the observation.

Report of Activities, Observations and Acoustic Monitoring: Atlantic Shores will provide NMFS with an annual report within 90 calendar days following the completion of construction and HRG surveys. Reporting will include a summary of the Project-related activities and an estimate of the numbers of marine mammals taken.

Report Information. All vessels for the Projects will utilize a standardized data entry format for collecting all marine mammal observations. Data collected will include distance from vessel, behavior, species, group size/composition within and outside of the designated SZs, monitoring effort, environmental conditions, details on the noise attenuation system(s) used and its performance and information on Project-related activity.

Weekly Reporting: During construction, weekly PSO and PAM reports briefly summarizing sightings, detections and activities, any mitigation actions (or if mitigation actions could not be taken, and reasons why), Reports will be provided to NMFS and BOEM on the immediate Wednesday following a Sunday-Saturday period.

Annual Reporting: An annual report summarizing the prior year's activities and reports will be provided to NMFS and to BOEM on April 1 every calendar year summarizing the prior year's activities.

NARW Reporting: Any NARW sightings will be reported as soon as feasible, and no later than within 24 hours, to the NMFS SAS hotline or via the WhaleAlert Application.

14. Suggested Means of Coordination

All PSO observation data (e.g., time, date, species identification, weather conditions, direction, behavioral observations) collected by Atlantic Shores during construction of the Projects will be provided to BOEM, NMFS, and other interested government agencies, thereby contributing to the knowledge of these protected species which may provide insights to future project planning and impact analysis. Additionally, the data will be made available to educational institutions, environmental groups, and other parties, upon request.

Atlantic Shores is also evaluating additional innovative technologies and methods to improve the monitoring of marine mammals within the Offshore Project Area and to further inform regional efforts to understand cumulative impacts to these species. Through partnerships with universities, governmental agencies and environmental non-governmental organizations, Atlantic Shores is working with marine mammal experts to identify key knowledge gaps and to plan studies to advance the general understanding of marine mammals in the Mid-Atlantic Bight.

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Appendix A. Alternate Take Estimates Using Construction Schedules 1 and 3

Three construction schedules (described in Section 2.2) were modeled to assess potential pile driving impacts. Construction Schedule 2 was used in calculating takes for this LOA request as a conservative measure because it results in the highest number of estimated Level A and Level B takes. All results in the main body of this LOA document use Construction Schedule 2. For comparison, take estimates are provided in this appendix for schedules 1 and 3 for the full project buildout (Appendix A.1) as well as for the Project 1 plus Overlap (Appendix A.2) and Project 2 plus Overlap (Appendix A.3) break down.

Construction Schedule 1 is based on a 2-year buildout and Construction Schedule 3 assumes a 1-year buildout. All three schedules assumed a pile installation schedule from May through December to avoid and minimize impacts to the NARW. No concurrent pile driving within the WTA was assumed for any of the schedules.

A.1. Full Buildout

Tables A-1 and A-2 show Construction Schedules 1 and 3 for the full buildout of Atlantic shores, including both Project 1 and Project 2.

Table A-1. Atlantic Shores Construction Schedule 1 – Full Buildout: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 1: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)		Year 2 # Days (# Piles)		Total # Days (# Piles)[b]	
	WTG Monopile 15 m (1 pile/day)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)
May	8 (8)	0 (0)	5	0 (0)	13	0 (0)
Jun	20 (20)	6 (24)	15	6 (24)	35	12 (48)
Jul	25 (25)	0 (0)	20	0 (0)	45	0 (0)
Aug	19 (19)	6 (24)	18	6 (24)	37	12 (48)
Sep	18 (18)	0 (0)	14	0 (0)	32	0 (0)
Oct	16 (16)	0 (0)	13	0 (0)	29	0 (0)
Nov	5 (5)	0 (0)	4	0 (0)	9	0 (0)
Dec	1 (1)	0 (0)	0	0 (0)	1	0 (0)
Total Piling Days	**112**	**12**	**89**	**12**	**201**	**24**
Total Piles	**112**	**48**	**89**	**48**	**201**[c]	**96**
Total Foundations	**112**	**2**	**89**	**2**	**201**	**4**

[a] The schedules assume a start year of 2026 for WTG foundation installation. Construction Schedule 1 is shown here for comparison. However, only Construction Schedule 2 is used in the take estimation.

[b] Modeling assumed 201 WTG foundations and 4 large OSSs.

[c] The PDE is inclusive of 200 WTG foundations and 1 Met tower on a WTG foundation.

Table A-2. Atlantic Shores Construction Schedule 3 – Full Buildout: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 3: 1-Year Schedule[a]				
	Year 1 # Days (# Piles)			Total # Days (# Piles)[b]	
	WTG Monopile 15 m (1 pile/day)	WTG Monopile 15 m (2 piles/day)	WTG Jacket 5 m (4 piles/d)	WTG Monopile 15 m (total)	OSS Jacket 5 m (total)
May	9 (9)	3 (6)	0	12 (15)	0
Jun	8 (8)	16 (32)	6 (24)	24 (40)	6 (24)
Jul	10 (10)	15 (30)	6 (24)	25 (40)	6 (24)
Aug	0 (0)	25 (50)	6 (24)	25 (50)	6 (24)
Sep	1 (1)	12 (24)	6 (24)	13 (25)	6 (24)
Oct	13 (13)	6 (12)	0	19 (25)	0
Nov	3 (3)	1 (2)	0	4 (5)	0
Dec	1 (1)	0 (0)	0	1 (1)	0
Total Piling Days	**45**	**78**	**24**	**123**	**24**
Total Piles	**45**	**156**	**96**	**201**	**96**
Total Foundations	**45**	**156**	**4**	**201**	**4**

[a] The schedules assume a start year of 2026 for WTG foundation installation. Construction Schedule 3 is shown here for comparison. However, only Construction Schedule 2 is used in the take estimation.

[b] Modeling assumed 201 WTG foundations and 4 large OSSs.

Tables A-3 through A-6 show exposure estimates and Tables A-7 and A-8 show take estimates calculated using Construction Schedules 1 and 3 for the full buildout by year and for the total construction schedule.

Table A-3. Construction Schedule 1, year 1 – Full Buildout: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	19.20	11.76	7.25	3.16	0.19	<0.01	0	0	36.57	26.56	21.40	16.82	32.17	21.86	16.95	12.39
	Minke whale	16.63	6.56	2.31	0.46	0.03	<0.01	0	0	48.24	36.54	29.82	23.46	35.74	26.12	20.77	15.89
	Humpback whale	3.86	2.15	1.14	0.40	0.03	<0.01	0	0	8.02	5.65	4.36	3.22	6.32	4.43	3.40	2.47
	North Atlantic right whale[d] (migrating)	2.01	0.81	0.37	0.08	0.01	<0.01	<0.01	<0.01	6.14	4.42	3.41	2.62	11.53	9.04	7.51	5.98
	Sei whale[d]	0.15	0.09	0.06	0.02	<0.01	<0.01	0	0	0.29	0.21	0.17	0.13	0.25	0.17	0.13	0.10
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	248.63	183.27	147.10	113.51	106.60	72.96	54.58	34.44
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	24.00	6.33	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	832.01	409.09	47.44	0	388.06	182.27	113.92	54.00
	Bottlenose dolphin, offshore	2.16	0	0	0	2.22	0	0	0	5572.52	4052.14	3142.72	2223.74	2357.66	1537.86	1096.62	708.98
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	10.16	7.43	5.99	4.57	4.52	3.11	2.35	1.50
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	19.78	6.16	1.40	0.34	11.56	5.04	2.53	0.58	109.66	80.25	65.02	49.47	285.52	214.82	175.10	133.00
PPW	Gray seal	1.18	0.33	0.07	0.02	0.04	0	0	0	17.47	11.65	8.51	6.35	11.04	7.00	5.30	3.59
	Harbor seal	3.45	0.74	0.18	0.01	0.20	0.04	0	0	40.85	26.98	20.29	15.15	25.64	16.47	12.48	8.50

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-4. Construction Schedule 1, year 2 – Full Buildout: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

	Species	Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	15.85	9.71	5.99	2.63	0.15	<0.01	0	0	29.88	21.69	17.47	13.73	26.29	17.87	13.83	10.11
	Minke whale	13.29	5.33	1.91	0.38	0.02	<0.01	0	0	37.58	28.39	23.15	18.14	27.80	20.28	16.12	12.31
	Humpback whale	3.07	1.71	0.91	0.32	0.02	<0.01	0	0	6.28	4.42	3.40	2.51	4.95	3.46	2.65	1.93
	North Atlantic right whale[d] (migrating)	1.14	0.46	0.22	0.05	<0.01	<0.01	<0.01	<0.01	3.40	2.43	1.88	1.43	6.42	5.03	4.18	3.32
	Sei whale[d]	0.11	0.07	0.04	0.02	<0.01	<0.01	0	0	0.21	0.15	0.12	0.10	0.19	0.13	0.10	0.07
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	193.68	142.33	114.20	87.82	84.57	57.93	43.36	27.37
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	19.82	5.42	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	720.32	351.14	39.28	0	348.47	162.83	102.67	48.55
	Bottlenose dolphin, offshore	2.16	0	0	0	1.83	0	0	0	4776.34	3465.01	2687.36	1896.25	2045.11	1337.60	954.84	617.24
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	8.82	6.45	5.20	3.96	3.96	2.73	2.06	1.32
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	13.45	4.33	1.10	0.29	7.62	3.32	1.67	0.38	72.59	53.09	43.00	32.71	189.65	142.80	116.46	88.51
PPW	Gray seal	0.91	0.27	0.06	0.01	0.02	0	0	0	11.50	7.63	5.58	4.16	7.35	4.66	3.54	2.38
	Harbor seal	2.57	0.62	0.17	0.01	0.12	0.03	0	0	26.86	17.70	13.25	9.88	17.06	10.96	8.31	5.63

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-5. Construction Schedule 1, years 1 and 2 combined – Full Buildout: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	35.05	21.47	13.25	5.79	0.33	<0.01	0	0	66.45	48.24	38.87	30.54	58.47	39.73	30.78	22.50
	Minke whale	29.92	11.89	4.22	0.84	0.05	<0.01	0	0	85.82	64.94	52.97	41.60	63.54	46.40	36.89	28.20
	Humpback whale	6.92	3.86	2.05	0.73	0.05	<0.01	0	0	14.29	10.07	7.76	5.73	11.26	7.89	6.05	4.41
	North Atlantic right whale[d] (migrating)	3.15	1.27	0.59	0.13	0.02	<0.01	<0.01	<0.01	9.54	6.86	5.29	4.05	17.96	14.07	11.69	9.30
	Sei whale[d]	0.26	0.16	0.10	0.04	<0.01	<0.01	0	0	0.50	0.36	0.29	0.23	0.44	0.30	0.23	0.17
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.04	0.02	0.02	0	0	0	0	0	442.31	325.60	261.30	201.32	191.17	130.89	97.94	61.81
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	43.82	11.76	2.79	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1552.33	760.22	86.72	0	736.54	345.11	216.58	102.55
	Bottlenose dolphin, offshore	4.32	0	0	0	4.05	0	0	0	10348.86	7517.16	5830.08	4120.00	4402.78	2875.45	2051.46	1326.21
	Risso’s dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	18.98	13.87	11.19	8.54	8.48	5.83	4.41	2.83
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	33.23	10.49	2.51	0.62	19.18	8.35	4.20	0.97	182.25	133.35	108.02	82.18	475.17	357.63	291.56	221.51
PPW	Gray seal	2.09	0.60	0.14	0.03	0.06	0	0	0	28.97	19.28	14.10	10.51	18.38	11.66	8.83	5.98
	Harbor seal	6.02	1.36	0.35	0.02	0.32	0.07	0	0	67.71	44.68	33.54	25.03	42.70	27.43	20.79	14.12

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-6. Construction Schedule 3, year 1 – Full Buildout: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

	Species	Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	34.41	20.40	12.33	5.37	0.28	0.04	0	0	61.93	46.17	37.83	29.90	53.41	36.63	28.77	21.34
	Minke whale	27.61	10.63	3.57	0.76	0.12	<0.01	0	0	79.15	60.91	50.07	39.67	58.22	43.01	34.39	26.39
	Humpback whale	6.48	3.47	1.84	0.66	0.05	<0.01	<0.01	<0.01	13.04	9.21	7.15	5.34	10.14	7.09	5.49	4.03
	North Atlantic right whale[d] (migrating)	3.13	1.28	0.58	0.14	0.01	<0.01	<0.01	<0.01	9.37	6.76	5.26	3.99	17.26	13.57	11.37	9.08
	Sei whale[d]	0.25	0.15	0.09	0.04	<0.01	<0.01	0	0	0.47	0.35	0.28	0.22	0.40	0.28	0.22	0.16
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.03	0.01	0.01	0	0	0	0	0	392.26	294.21	238.87	185.54	168.32	116.13	86.93	54.79
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	40.63	10.88	2.69	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	1511.94	770.78	80.75	0	690.01	338.97	206.66	102.52
	Bottlenose dolphin, offshore	4.03	0	0	0	2.44	1.81	1.81	0	9816.44	7126.28	5590.79	4116.28	4179.02	2825.85	2023.55	1266.57
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	18.82	14.06	11.49	8.99	8.52	5.95	4.52	2.98
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	26.68	7.40	2.00	0.48	14.47	5.82	2.66	0.71	144.12	106.69	86.23	66.17	352.17	268.47	220.75	170.96
PPW	Gray seal	1.58	0.37	0.07	0.02	0.08	<0.01	0	0	26.37	17.73	13.16	9.69	16.14	10.43	7.94	5.37
	Harbor seal	4.79	0.97	0.22	0.03	0.33	0.07	0	0	61.41	41.04	30.85	22.69	37.52	24.40	18.47	12.56

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-7. Level A and Level B Take estimates for impact pile driving – Construction Schedule 1, Full Buildout.

Species		Stock Size	Year 2			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	8	22	0.44	6	18	0.35	14	39	0.78
	Minke whale	21968	3	30	0.15	2	24	0.12	5	53	0.26
	Humpback whale	1396	2	5	0.50	1	4	0.36	3	8	0.79
	North Atlantic right whale[a,b]	368	0	4	1.09	0	4	1.09	0	8	2.17
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06	1	6	0.11
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25	0	200	0.50
	Atlantic white-sided dolphin	93233	1	148	0.16	1	115	0.12	1	262	0.28
	Short-beaked common dolphin[c]	172974	0	193	0.11	0	157	0.09	0	349	0.20
	Bottlenose dolphin, coastal	6639	0	48	0.72	0	40	0.60	0	87	1.31
	Bottlenose dolphin, offshore	62851	0	3143	5.00	0	2688	4.28	0	5831	9.28
	Risso’s dolphin[b]	35215	1	30	0.09	1	30	0.09	1	60	0.17
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05	0	40	0.10
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02	0	12	0.04
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05	0	4	0.09
HF	Harbor porpoise	95543	3	66	0.07	2	43	0.05	5	109	0.12
PPW	Gray seal	27300	1	9	0.04	1	6	0.03	1	15	0.06
	Harbor seal	61336	1	21	0.04	1	14	0.02	1	34	0.06

[a] Listed as Endangered under the ESA.

[b] Take estimate rounded up to one average group size for yearly take and to two average group sizes for total take estimates.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

Table A-8. Level A and Level B Take estimates for impact pile driving – Construction Schedule 3, Full Buildout.

Species		Stock Size	Year 2			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %
LF	Fin whale[a]	6802	13	38	0.75	13	38	0.75
	Minke whale	21968	4	51	0.25	4	51	0.25
	Humpback whale	1396	2	8	0.72	2	8	0.72
	North Atlantic right whale[a]	368	0	6	1.63	0	6	1.63
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25
	Atlantic white-sided dolphin	93233	1	239	0.26	1	239	0.26
	Short-beaked common dolphin[c]	172974	0	228	0.13	0	228	0.13
	Bottlenose dolphin, coastal	6639	0	81	1.22	0	81	1.22
	Bottlenose dolphin, offshore	62851	2	5591	8.90	2	5591	8.90
	Risso's dolphin[b]	35215	1	30	0.09	1	30	0.09
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05
HF	Harbor porpoise	95543	3	87	0.09	3	87	0.09
PPW	Gray seal	27300	1	14	0.05	1	14	0.05
	Harbor seal	61336	1	31	0.05	1	31	0.05

[a] Listed as Endangered under the ESA.

[b] Take estimate rounded up to one average group size for yearly take and to two average group sizes for total take estimates.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

A.2. Project 1 Plus Overlap

Tables A-9 and A-10 show Construction Schedules 1 and 3 for the Project 1 plus Overlap case.

Table A-9. Atlantic Shores Construction Schedule 1 – Project 1 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 1: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)[b]		Year 2 # Days (# Piles)		Total # Days (# Piles)	
	WTG Monopile 15 m (1 pile/day)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)
May	8 (8)	0 (0)	0 (0)	0 (0)	8 (8)	0 (0)
Jun	20 (20)	6 (24)	0 (0)	0 (0)	20 (20)	6 (24)
Jul	25 (25)	0 (0)	0 (0)	0 (0)	25 (25)	0 (0)
Aug	19 (19)	6 (24)	0 (0)	0 (0)	19 (19)	6 (24)
Sep	18 (18)	0 (0)	0 (0)	0 (0)	18 (18)	0 (0)
Oct	16 (16)	0 (0)	0 (0)	0 (0)	16 (16)	0 (0)
Nov[c]	5 (5)	0 (0)	0 (0)	0 (0)	5 (5)	0 (0)
Dec[c]	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)
Total Piling Days	**112**	**12**	**0**	**0**	**112**	**12**
Total Piles	**112**	**48**	**0**	**0**	**112**	**48**
Total Foundations	**112**	**2**	**0**	**0**	**112**	**2**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopiles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. This schedule is shown here for comparison; however, only Construction Schedule 2 is used in the take request.

[b] Modeling assumed 106 WTG foundations (105 WTGs + 1 Met Tower) installed during May–October in the Project 1 Area plus an additional 6 WTG foundations installed during November–December in the Overlap Area as well as 2 large OSSs installed during June and August in the Project 1 Area. All foundation installation for Project 1 plus Overlap would occur during year 1.

[c] The 6 WTG foundations installed during November–December are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

Table A-10. Atlantic Shores Construction Schedule 3 – Project 1 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 3: 1-Year Schedule[a]				
	Year 1 # Days (# Piles)			Total # Days (# Piles)[b]	
	WTG Monopile 15 m (1 pile/day)	WTG Monopile 15 m (2 piles/day)	WTG Jacket 5 m (4 piles/d)	WTG Monopile 15 m (total)	OSS Jacket 5 m (total)
May	9 (9)	3 (6)	0	12 (15)	0
Jun	8 (8)	16 (32)	6 (24)	24 (40)	6 (24)
Jul	10 (10)	15 (30)	6 (24)	25 (40)	6 (24)
Aug[c]	1 (1)	8 (16)	0 (0)	9 (33)	0 (0)
Sep	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Oct	0 (0)	0 (0)	0 (0)	0 (0)	0
Nov	0 (0)	0 (0)	0 (0)	0 (0)	0
Dec	0 (0)	0 (0)	0 (0)	0 (0)	0
Total Piling Days	**28**	**42**	**12**	**70**	**12**
Total Piles	**28**	**84**	**48**	**112**	**48**
Total Foundations	**28**	**84**	**2**	**112**	**2**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 3 is a one-year schedule that assumes all foundations are installed for both projects in one year. All WTGs and the met tower are installed on 15 m monopiles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. This schedule is shown here for comparison; however, only Construction Schedule 2 is used in the take request.

[b] Modeling assumed 106 WTG foundations (105 WTGs + 1 Met Tower) installed during May–August in the Project 1 Area plus an additional 6 WTG foundations installed during August in the Overlap Area as well as 2 large OSSs installed during June and July in the Project 1 Area.

[c] Six of the WTG foundations installed during August are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

Tables A-11 through A-14 show exposure estimates and Tables A-15 and A-16 show take estimates calculated using Construction Schedules 1 and 3 for Project 1 plus Overlap by year and for the total construction schedule.

Table A-11. Construction Schedule 1, year 1 – Project 1 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	19.20	11.76	7.25	3.16	0.19	<0.01	0	0	36.57	26.56	21.40	16.82	32.17	21.86	16.95	12.39
	Minke whale	16.63	6.56	2.31	0.46	0.03	<0.01	0	0	48.24	36.54	29.82	23.46	35.74	26.12	20.77	15.89
	Humpback whale	3.86	2.15	1.14	0.40	0.03	<0.01	0	0	8.02	5.65	4.36	3.22	6.32	4.43	3.40	2.47
	North Atlantic right whale[d] (migrating)	2.01	0.81	0.37	0.08	0.01	<0.01	<0.01	<0.01	6.14	4.42	3.41	2.62	11.53	9.04	7.51	5.98
	Sei whale[d]	0.15	0.09	0.06	0.02	<0.01	<0.01	0	0	0.29	0.21	0.17	0.13	0.25	0.17	0.13	0.10
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	248.63	183.27	147.10	113.51	106.60	72.96	54.58	34.44
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	24.00	6.33	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	832.01	409.09	47.44	0	388.06	182.27	113.92	54.00
	Bottlenose dolphin, offshore	2.16	0	0	0	2.22	0	0	0	5572.52	4052.14	3142.72	2223.74	2357.66	1537.86	1096.62	708.98
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	10.16	7.43	5.99	4.57	4.52	3.11	2.35	1.50
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	19.78	6.16	1.40	0.34	11.56	5.04	2.53	0.58	109.66	80.25	65.02	49.47	285.52	214.82	175.10	133.00
PPW	Gray seal	1.18	0.33	0.07	0.02	0.04	0	0	0	17.47	11.65	8.51	6.35	11.04	7.00	5.30	3.59
	Harbor seal	3.45	0.74	0.18	0.01	0.20	0.04	0	0	40.85	26.98	20.29	15.15	25.64	16.47	12.48	8.50

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-12. Construction Schedule 1, year 2 – Project 1 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day. No exposures are attributed to Project 1 during year 2 because buildout of Project 1 is completed during year 1 of this schedule.

Species		**Injury**								**Behavior**							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								**Attenuation (dB)** [c]							
		0	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**
LF	Fin whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Minke whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Humpback whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	North Atlantic right whale[d] (migrating)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sei whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bottlenose dolphin, offshore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Risso's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PPW	Gray seal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-13. Construction Schedule 1, years 1 and 2 combined – Project 1 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	19.20	11.76	7.25	3.16	0.19	<0.01	0	0	36.57	26.56	21.40	16.82	32.17	21.86	16.95	12.39
	Minke whale	16.63	6.56	2.31	0.46	0.03	<0.01	0	0	48.24	36.54	29.82	23.46	35.74	26.12	20.77	15.89
	Humpback whale	3.86	2.15	1.14	0.40	0.03	<0.01	0	0	8.02	5.65	4.36	3.22	6.32	4.43	3.40	2.47
	North Atlantic right whale[d] (migrating)	2.01	0.81	0.37	0.08	0.01	<0.01	<0.01	<0.01	6.14	4.42	3.41	2.62	11.53	9.04	7.51	5.98
	Sei whale[d]	0.15	0.09	0.06	0.02	<0.01	<0.01	0	0	0.29	0.21	0.17	0.13	0.25	0.17	0.13	0.10
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	248.63	183.27	147.10	113.51	106.60	72.96	54.58	34.44
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	24.00	6.33	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	832.01	409.09	47.44	0	388.06	182.27	113.92	54.00
	Bottlenose dolphin, offshore	2.16	0	0	0	2.22	0	0	0	5572.52	4052.14	3142.72	2223.74	2357.66	1537.86	1096.62	708.98
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	10.16	7.43	5.99	4.57	4.52	3.11	2.35	1.50
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	19.78	6.16	1.40	0.34	11.56	5.04	2.53	0.58	109.66	80.25	65.02	49.47	285.52	214.82	175.10	133.00
PPW	Gray seal	1.18	0.33	0.07	0.02	0.04	0	0	0	17.47	11.65	8.51	6.35	11.04	7.00	5.30	3.59
	Harbor seal	3.45	0.74	0.18	0.01	0.20	0.04	0	0	40.85	26.98	20.29	15.15	25.64	16.47	12.48	8.50

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-14. Construction Schedule 3, year 1 – Project 1 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	20.96	12.43	7.52	3.27	0.17	0.02	0	0	37.83	28.20	23.10	18.26	32.64	22.38	17.58	13.04
	Minke whale	21.80	8.41	2.84	0.60	0.10	<0.01	0	0	62.28	47.92	39.38	31.18	45.81	33.83	27.05	20.75
	Humpback whale	3.35	1.79	0.95	0.34	0.03	<0.01	<0.01	<0.01	6.69	4.71	3.66	2.73	5.20	3.63	2.81	2.06
	North Atlantic right whale[d] (migrating)	2.10	0.86	0.39	0.09	<0.01	<0.01	<0.01	<0.01	6.26	4.52	3.52	2.67	11.50	9.04	7.59	6.06
	Sei whale[d]	0.19	0.11	0.07	0.03	<0.01	<0.01	0	0	0.35	0.26	0.21	0.17	0.30	0.21	0.16	0.12
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	0.01	0.01	0	0	0	0	0	290.86	217.99	177.01	137.34	125.71	86.77	64.96	40.95
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	20.03	5.39	1.36	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	842.55	432.86	47.37	0	369.01	182.40	110.06	54.78
	Bottlenose dolphin, offshore	1.77	0	0	0	1.41	0.93	0.93	0	5228.18	3805.45	2984.31	2200.69	2196.07	1479.66	1058.27	662.78
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	10.19	7.62	6.22	4.87	4.54	3.17	2.41	1.58
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	10.72	2.98	0.85	0.21	5.70	2.27	1.03	0.28	57.19	42.38	34.24	26.29	138.93	106.10	87.34	67.80
PPW	Gray seal	1.20	0.30	0.06	0.01	0.06	<0.01	0	0	18.56	12.46	9.27	6.81	11.38	7.37	5.62	3.79
	Harbor seal	3.59	0.79	0.19	0.02	0.23	0.05	0	0	43.17	28.86	21.64	15.87	26.45	17.22	13.04	8.84

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-15. Level A and Level B Take estimates for impact pile driving – Construction Schedule 1, Project 1 plus Overlap.

Species		Stock Size	Year 2			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	8	22	0.44	0	0	0	8	22	0.44
	Minke whale	21968	3	30	0.15	0	0	0	3	30	0.15
	Humpback whale	1396	2	5	0.50	0	0	0	2	5	0.50
	North Atlantic right whale[a,b]	368	0	4	1.09	0	0	0	0	4	1.09
	Sei whale[a,b]	6292	1	3	0.06	0	0	0	1	3	0.06
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	0	0	0	100	0.25
	Atlantic white-sided dolphin	93233	1	148	0.16	0	0	0	1	148	0.16
	Short-beaked common dolphin[c]	172974	0	193	0.11	0	0	0	0	193	0.11
	Bottlenose dolphin, coastal	6639	0	48	0.72	0	0	0	0	48	0.72
	Bottlenose dolphin, offshore	62851	0	3143	5.00	0	0	0	0	3143	5.00
	Risso's dolphin[b]	35215	1	30	0.09	0	0	0	1	30	0.09
	Long-finned pilot whale[bb]	39215	0	20	0.05	0	0	0	0	20	0.05
	Short-finned pilot whale	28924	0	6	0.02	0	0	0	0	6	0.02
	Sperm whale[a,b]	4349	0	2	0.05	0	0	0	0	2	0.05
HF	Harbor porpoise	95543	3	66	0.07	0	0	0	3	66	0.07
PPW	Gray seal	27300	1	9	0.04	0	0	0	1	9	0.04
	Harbor seal	61336	1	21	0.04	0	0	0	1	21	0.04

[a] Listed as Endangered under the ESA.

[b] Yearly take estimate rounded up to one average group size.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

Table A-16. Level A and Level B Take estimates for impact pile driving – Construction Schedule 3, Project 1 plus Overlap.

Species		Stock Size	Year 2			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %
LF	Fin whale[a]	6802	8	24	0.47	8	24	0.47
	Minke whale	21968	3	40	0.20	3	40	0.20
	Humpback whale	1396	1	4	0.36	1	4	0.36
	North Atlantic right whale[a]	368	0	4	1.09	0	4	1.09
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25
	Atlantic white-sided dolphin	93233	1	178	0.19	1	178	0.19
	Short-beaked common dolphin[c]	172974	0	128	0.07	0	128	0.07
	Bottlenose dolphin, coastal	6639	0	48	0.72	0	48	0.72
	Bottlenose dolphin, offshore	62851	1	2985	4.75	1	2985	4.75
	Risso's dolphin[b]	35215	1	30	0.09	1	30	0.09
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05
HF	Harbor porpoise	95543	2	35	0.04	2	35	0.04
PPW	Gray seal	27300	1	10	0.04	1	10	0.04
	Harbor seal	61336	1	22	0.04	1	22	0.04

[a] Listed as Endangered under the ESA.

[b] Yearly take estimate rounded up to one average group size.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

A.3. Project 2 Plus Overlap

Tables A-17 and A-18 show Construction Schedules 1 and 3 for the Project 2 plus Overlap case.

Table A-17. Atlantic Shores Construction Schedule 1 – Project 2 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 1: 2-Year Schedule[a]					
	Year 1 # Days (# Piles)		Year 2 # Days (# Piles)		Total # Days (# Piles)[b]	
	WTG Monopile 15 m (1 pile/day)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)	WTG Monopile 15 m (1 pile/d)	OSS Jacket 5 m (4 piles/d)
May	0 (0)	0 (0)	5 (5)	0 (0)	5 (5)	0 (0)
Jun	0 (0)	0 (0)	15 (15)	6 (24)	15 (15)	6 (24)
Jul	0 (0)	0 (0)	20 (20)	0 (0)	20 (20)	0 (0)
Aug	0 (0)	0 (0)	18 (18)	6 (24)	18 (18)	6 (24)
Sep	0 (0)	0 (0)	14 (14)	0 (0)	14 (14)	0 (0)
Oct	0 (0)	0 (0)	13 (13)	0 (0)	13 (13)	0 (0)
Nov	5 (5)	0 (0)	4 (4)	0 (0)	9 (9)	0 (0)
Dec	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)
Total Piling Days	**6**	**0**	**89**	**12**	**95**	**12**
Total Piles	**6**	**0**	**89**	**48**	**95**	**48**
Total Foundations	**6**	**0**	**89**	**2**	**95**	**4**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopiles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. This schedule is shown here for comparison; however, only Construction Schedule 2 is used in the take request.

[b] Modeling assumed 6 WTG foundations installed during November–December of year 1 in the Overlap Area as well as 89 WTG foundations installed during May–December of year 2 plus two large OSSs installed during June and August of year 2 in the Project 2 Area.

[c] The 6 WTG foundations installed during November–December of year 1 are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

Table A-18. Atlantic Shores Construction Schedule 3 – Project 2 plus Overlap: Used to estimate marine mammal exposures above threshold criteria. Shown are the number of piling days (number of piles) for each construction month and year.

Construction Month	Construction Schedule 3: 1-Year Schedule[a]				
	Year 1 # Days (# Piles)			Total # Days (# Piles)[b]	
	WTG Monopile 15 m (1 pile/day)	WTG Monopile 15 m (2 piles/day)	WTG Jacket 5 m (4 piles/d)	WTG Monopile 15 m (total)	OSS Jacket 5 m (total)
May	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Jun	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Jul	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Aug	1 (1)	19 (38)	6 (24)	20 (39)	6 (24)
Sep	1 (1)	12 (24)	6 (24)	13 (25)	6 (24)
Oct	13 (13)	6 (12)	0 (0)	19 (25)	0 (0)
Nov	3 (3)	1 (2)	0 (0)	4 (5)	0 (0)
Dec	1 (1)	0 (0)	0 (0)	1 (1)	0 (0)
Total Piling Days	**19**	**38**	**12**	**57**	**12**
Total Piles	**19**	**76**	**48**	**95**	**48**
Total Foundations	**19**	**76**	**2**	**95**	**2**

[a] The schedules assume a start year of 2026 for foundation installation. Construction Schedule 3 is a one-year schedule that assumes all foundations are installed for both projects in one year. All WTGs and the met tower are installed on 15 m monopiles and OSSs are installed on jacket foundations each with twenty-four 5-m pin piles. This schedule is shown here for comparison; however, only Construction Schedule 2 is used in the take request.

[b] Modeling assumed 89 WTG foundations installed during May–August in the Project 2 Area plus an additional 6 WTG foundations installed during August in the Overlap Area as well as 2 large OSSs installed during August and September in the Project 2 Area.

[c] Six of the WTG foundations installed during August are part of the Overlap Area and are counted in both the Project 1 plus Overlap and Project 2 plus Overlap exposure and take estimates.

Tables A-19 through A-22 show exposure estimates and Tables A-23 and A-24 show take estimates calculated using Construction Schedules 1 and 3 for Project 2 plus Overlap by year and for the total construction schedule.

Table A-19. Construction Schedule 1, year 1 – Project 2 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		Injury								Behavior							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								Attenuation (dB) [c]							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[d]	0.47	0.29	0.18	0.08	<0.01	0	0	0	0.95	0.69	0.56	0.44	0.83	0.57	0.44	0.32
	Minke whale	0.33	0.12	0.04	<0.01	<0.01	0	0	0	1.04	0.80	0.65	0.52	0.78	0.57	0.45	0.35
	Humpback whale	0.29	0.17	0.09	0.03	<0.01	<0.01	0	0	0.65	0.46	0.36	0.26	0.51	0.36	0.28	0.20
	North Atlantic right whale[d] (migrating)	0.67	0.26	0.12	0.03	<0.01	<0.01	<0.01	<0.01	2.10	1.52	1.17	0.90	3.91	3.07	2.55	2.03
	Sei whale[d]	<0.01	<0.01	<0.01	<0.01	<0.01	0	0	0	0.02	0.01	0.01	<0.01	0.02	0.01	<0.01	<0.01
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	18.10	13.48	10.84	8.46	7.25	4.95	3.70	2.33
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	2.08	0.45	0	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	11.54	5.99	0.84	0	4.09	2.01	1.16	0.56
	Bottlenose dolphin, offshore	0	0	0	0	0.04	0	0	0	87.45	64.49	50.02	35.97	34.33	22.00	15.57	10.08
	Risso's dolphin	0	0	0	0	0	0	0	0	0.17	0.13	0.10	0.08	0.07	0.05	0.04	0.02
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	Harbor porpoise (sensitive)	10.71	3.11	0.51	0.08	6.67	2.91	1.47	0.34	62.74	45.96	37.26	28.36	162.23	121.88	99.24	75.28
PPW	Gray seal	0.16	0.03	<0.01	<0.01	<0.01	0	0	0	3.63	2.45	1.78	1.33	2.24	1.42	1.07	0.73
	Harbor seal	0.53	0.07	<0.01	0	0.05	<0.01	0	0	8.50	5.65	4.28	3.21	5.21	3.36	2.54	1.74

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-20. Construction Schedule 1, year 2 – Project 2 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		**Injury**								**Behavior**							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								**Attenuation (dB) [c]**							
		0	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**
LF	Fin whale[d]	15.85	9.71	5.99	2.63	0.15	<0.01	0	0	29.88	21.69	17.47	13.73	26.29	17.87	13.83	10.11
	Minke whale	13.29	5.33	1.91	0.38	0.02	<0.01	0	0	37.58	28.39	23.15	18.14	27.80	20.28	16.12	12.31
	Humpback whale	3.07	1.71	0.91	0.32	0.02	<0.01	0	0	6.28	4.42	3.40	2.51	4.95	3.46	2.65	1.93
	North Atlantic right whale[d] (migrating)	1.14	0.46	0.22	0.05	<0.01	<0.01	<0.01	<0.01	3.40	2.43	1.88	1.43	6.42	5.03	4.18	3.32
	Sei whale[d]	0.11	0.07	0.04	0.02	<0.01	<0.01	0	0	0.21	0.15	0.12	0.10	0.19	0.13	0.10	0.07
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	193.68	142.33	114.20	87.82	84.57	57.93	43.36	27.37
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	19.82	5.42	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	720.32	351.14	39.28	0	348.47	162.83	102.67	48.55
	Bottlenose dolphin, offshore	2.16	0	0	0	1.83	0	0	0	4776.34	3465.01	2687.36	1896.25	2045.11	1337.60	954.84	617.24
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	8.82	6.45	5.20	3.96	3.96	2.73	2.06	1.32
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	13.45	4.33	1.10	0.29	7.62	3.32	1.67	0.38	72.59	53.09	43.00	32.71	189.65	142.80	116.46	88.51
PPW	Gray seal	0.91	0.27	0.06	0.01	0.02	0	0	0	11.50	7.63	5.58	4.16	7.35	4.66	3.54	2.38
	Harbor seal	2.57	0.62	0.17	0.01	0.12	0.03	0	0	26.86	17.70	13.25	9.88	17.06	10.96	8.31	5.63

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-21. Construction Schedule 1, years 1 and 2 combined – Project 2 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

Species		**Injury**								**Behavior**							
		L_E				L_{pk}				L_p [a]				L_p [b]			
		Attenuation (dB) [c]								**Attenuation (dB)** [c]							
		0	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**
LF	Fin whale[d]	16.33	10.00	6.17	2.70	0.15	<0.01	0	0	30.83	22.38	18.03	14.16	27.13	18.43	14.27	10.43
	Minke whale	13.62	5.45	1.95	0.39	0.02	<0.01	0	0	38.62	29.19	23.80	18.66	28.57	20.85	16.57	12.66
	Humpback whale	3.36	1.87	1.00	0.35	0.02	<0.01	0	0	6.92	4.88	3.76	2.77	5.46	3.82	2.93	2.13
	North Atlantic right whale[d] (migrating)	1.81	0.72	0.34	0.08	<0.01	<0.01	<0.01	<0.01	5.49	3.95	3.05	2.34	10.33	8.09	6.73	5.35
	Sei whale[d]	0.12	0.07	0.05	0.02	<0.01	<0.01	0	0	0.23	0.17	0.13	0.11	0.20	0.14	0.11	0.08
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	0.02	<0.01	<0.01	0	0	0	0	0	211.78	155.82	125.03	96.28	91.82	62.88	47.05	29.70
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	21.91	5.88	1.39	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	731.86	357.12	40.12	0	352.56	164.84	103.83	49.11
	Bottlenose dolphin, offshore	2.16	0	0	0	1.87	0	0	0	4863.79	3529.50	2737.38	1932.22	2079.44	1359.59	970.41	627.31
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	9.00	6.57	5.30	4.04	4.04	2.78	2.10	1.35
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	24.16	7.43	1.61	0.37	14.29	6.23	3.14	0.72	135.33	99.06	80.26	61.07	351.88	264.68	215.70	163.79
PPW	Gray seal	1.08	0.31	0.07	0.02	0.03	0	0	0	15.13	10.07	7.36	5.49	9.59	6.08	4.61	3.12
	Harbor seal	3.11	0.69	0.18	0.01	0.17	0.04	0	0	35.37	23.35	17.53	13.09	22.28	14.31	10.85	7.37

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-22. Construction Schedule 3, year 1 – Project 2 plus Overlap: Mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction Schedule 1 assumes all WTGs and the met tower are installed on 15 m monopile foundations at a rate of one installation per day, and all OSSs are installed on jacket foundations. OSS jacket foundations use twenty-four 5 m pin piles and pin piles are installed at a rate of 4 pin piles per day.

	Species	**Injury**								**Behavior**							
		L_E				**L_{pk}**				**L_p [a]**				**L_p [b]**			
		Attenuation (dB) [c]								**Attenuation (dB) [c]**							
		0	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**	**0**	**6**	**10**	**15**
LF	Fin whale[d]	13.95	8.26	5.00	2.18	0.11	0.02	0	0	25.06	18.69	15.32	12.11	21.60	14.82	11.64	8.64
	Minke whale	5.91	2.25	0.75	0.16	0.03	<0.01	0	0	17.20	13.26	10.91	8.66	12.67	9.37	7.49	5.75
	Humpback whale	3.17	1.70	0.90	0.32	0.03	<0.01	<0.01	<0.01	6.46	4.56	3.55	2.65	5.02	3.51	2.72	2.00
	North Atlantic right whale[d] (migrating)	1.04	0.43	0.19	0.05	<0.01	<0.01	<0.01	<0.01	3.15	2.27	1.76	1.34	5.82	4.58	3.83	3.05
	Sei whale[d]	0.06	0.04	0.02	<0.01	<0.01	<0.01	0	0	0.12	0.09	0.07	0.06	0.10	0.07	0.06	0.04
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Atlantic white-sided dolphin	<0.01	<0.01	<0.01	0	0	0	0	0	102.53	77.07	62.56	48.75	43.07	29.68	22.20	13.98
	Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	21.49	5.68	1.33	0
	Bottlenose dolphin, coastal	0	0	0	0	0	0	0	0	728.15	369.44	37.46	0	341.32	167.12	102.52	50.78
	Bottlenose dolphin, offshore	2.26	0	0	0	1.15	0.94	0.94	0	4956.49	3592.17	2819.22	2074.48	2127.78	1442.49	1033.76	646.60
	Risso's dolphin	<0.01	<0.01	<0.01	0	<0.01	0	0	0	9.50	7.10	5.80	4.54	4.35	3.04	2.31	1.52
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[d]	0	0	0	0	0	0	0	0	0	0	0	0	<0.01	0	0	0
HF	Harbor porpoise (sensitive)	16.13	4.46	1.16	0.27	8.86	3.58	1.65	0.44	87.88	65.01	52.56	40.31	215.41	164.04	134.79	104.24
PPW	Gray seal	0.37	0.07	<0.01	<0.01	0.02	<0.01	0	0	7.83	5.29	3.89	2.89	4.77	3.06	2.32	1.58
	Harbor seal	1.20	0.19	0.03	<0.01	0.10	0.02	0	0	18.28	12.21	9.23	6.84	11.09	7.19	5.44	3.72

[a] NOAA (2005).

[b] Wood et al. (2012).

[c] Different levels of broadband sound attenuation are shown for comparison; Atlantic Shores is committing to a sound level attenuation of 10 dB.

[d] Listed as Endangered under the ESA.

Table A-23. Level A and Level B Take estimates for impact pile driving – Construction Schedule 1, Project 2 plus overlap.

Species		Stock Size	Year 2			Year 3			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %	Level A	Level B	Max. %
LF	Fin whale[a]	6802	1	2	0.04	6	18	0.35	7	19	0.38
	Minke whale	21968	1	2	0.01	2	24	0.12	2	24	0.12
	Humpback whale	1396	1	2	0.21	1	4	0.36	1	4	0.36
	North Atlantic right whale[a,b]	368	0	4	1.09	0	4	1.09	0	8	2.17
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06	1	6	0.11
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25	0	200	0.50
	Atlantic white-sided dolphin	93233	0	22	0.02	1	115	0.12	1	126	0.14
	Short-beaked common dolphin[c]	172974	0	10	0.01	0	157	0.09	0	166	0.10
	Bottlenose dolphin, coastal	6639	0	14	0.21	0	40	0.60	0	41	0.62
	Bottlenose dolphin, offshore	62851	0	51	0.08	0	2688	4.28	0	2738	4.36
	Risso's dolphin[b]	35215	0	30	0.09	1	30	0.09	1	60	0.17
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05	0	40	0.10
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02	0	12	0.04
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05	0	4	0.09
HF	Harbor porpoise	95543	2	38	0.04	2	43	0.05	4	81	0.09
PPW	Gray seal	27300	1	2	0.01	1	6	0.03	1	8	0.03
	Harbor seal	61336	1	5	0.01	1	14	0.02	1	18	0.03

[a] Listed as Endangered under the ESA.

[b] Take estimates rounded up to one average group size for Year 3 and to two average group sizes for total take estimates. For Year 2 take, because of the limit amount of pile driving, takes for all species except offshore bottlenose dolphins, harbor porpoise, and seals were estimated as zero. As a conservative measure, takes for the other species were rounded up to one average group size.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.

Table A-24. Level A and Level B Take estimates for impact pile driving – Construction Schedule 3, Project 2 plus Overlap.

Species		Stock Size	Year 2			Total		
			Level A	Level B	Max. %[d]	Level A	Level B	Max. %
LF	Fin whale[a]	6802	5	16	0.31	5	16	0.31
	Minke whale	21968	1	11	0.05	1	11	0.05
	Humpback whale	1396	1	4	0.36	1	4	0.36
	North Atlantic right whale[a,b]	368	0	4	1.09	0	4	1.09
	Sei whale[a,b]	6292	1	3	0.06	1	3	0.06
MF	Atlantic spotted dolphin[b]	39921	0	100	0.25	0	100	0.25
	Atlantic white-sided dolphin	93233	1	63	0.07	1	63	0.07
	Short-beaked common dolphin[c]	172974	0	107	0.06	0	107	0.06
	Bottlenose dolphin, coastal	6639	0	38	0.57	0	38	0.57
	Bottlenose dolphin, offshore	62851	1	2820	4.49	1	2820	4.49
	Risso's dolphin[b]	35215	1	30	0.09	1	30	0.09
	Long-finned pilot whale[b]	39215	0	20	0.05	0	20	0.05
	Short-finned pilot whale[b]	28924	0	6	0.02	0	6	0.02
	Sperm whale[a,b]	4349	0	2	0.05	0	2	0.05
HF	Harbor porpoise	95543	2	53	0.06	2	53	0.06
PPW	Gray seal	27300	1	4	0.02	1	4	0.02
	Harbor seal	61336	1	10	0.02	1	10	0.02

[a] Listed as Endangered under the ESA.

[b] Take estimate rounded up to one average group size for yearly take estimates.

[c] Take estimate for short-beaked common dolphins is the daily sighting rate from site characterization surveys multiplied by the number of pile driving days.

[d] Max % is the maximum percentage of the species' stock that could be taken annually, calculated as Level A take plus Level B take divided by stock size, multiplied by 100.